

BIM & Sustainability

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I am Omar Selim
Founder of BIMarabia

- BIM Manager
- CAD / 3D Visualization
- Specialist / CAD Manager / BIM Instructor / Technical Support Manager
- Research assistant at Qatar University
- This experience includes architectural drawings , architectural planning and detailing. Expert user in Revit, NAVISWORKS, AutoCAD and QTO.
- I have been working in many projects using BIM technique starting from the Conceptual Design up to Construction documents, this projects include a lot of types, such as Hotels, mixed use building, Hospitals , Mosques, Villas

I am here because I love to share Knowledge.

You can find me at @BIMarabia



Sustainability

- - Development “meeting the needs of the present generation without compromising the ability of future generations to meet their needs.” – Brundtland Report



BIM to BPA platform and solutions…

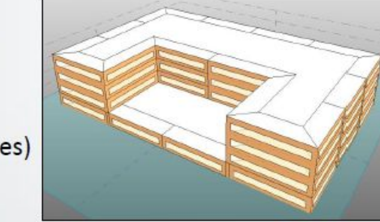
Building Information Modeling

Building Performance Analysis

Revit
(building elements)

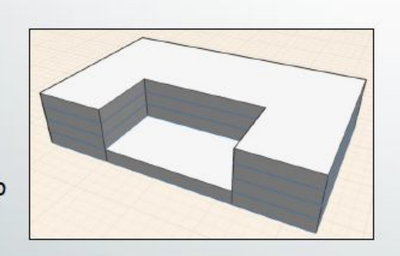


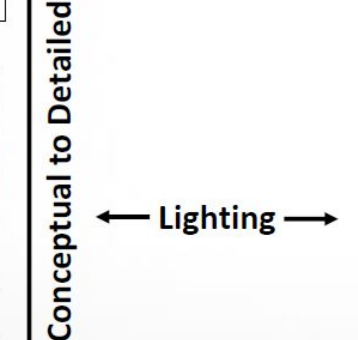
Vasari
(conceptual masses)

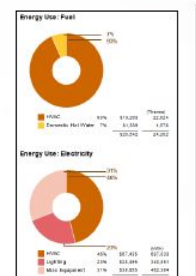


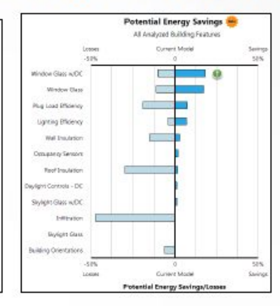


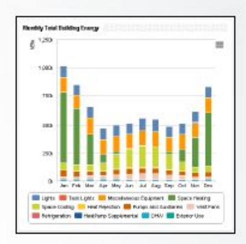
FormIt
iOS, Android, Web



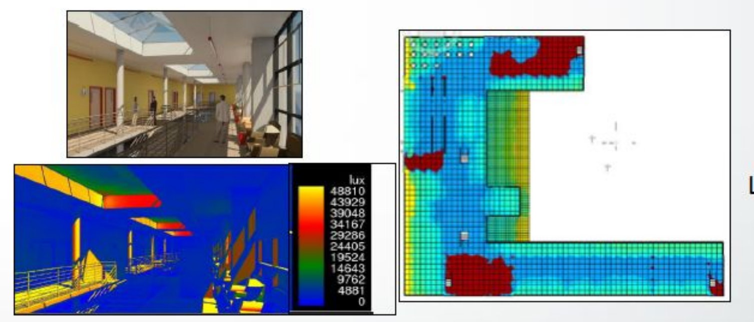






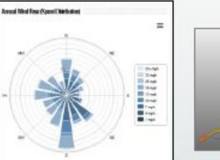


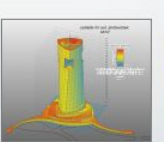
Green Building Studio & Project Solon

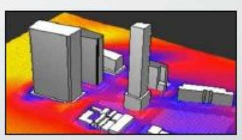


A360 Rendering & Lighting Analysis for Revit

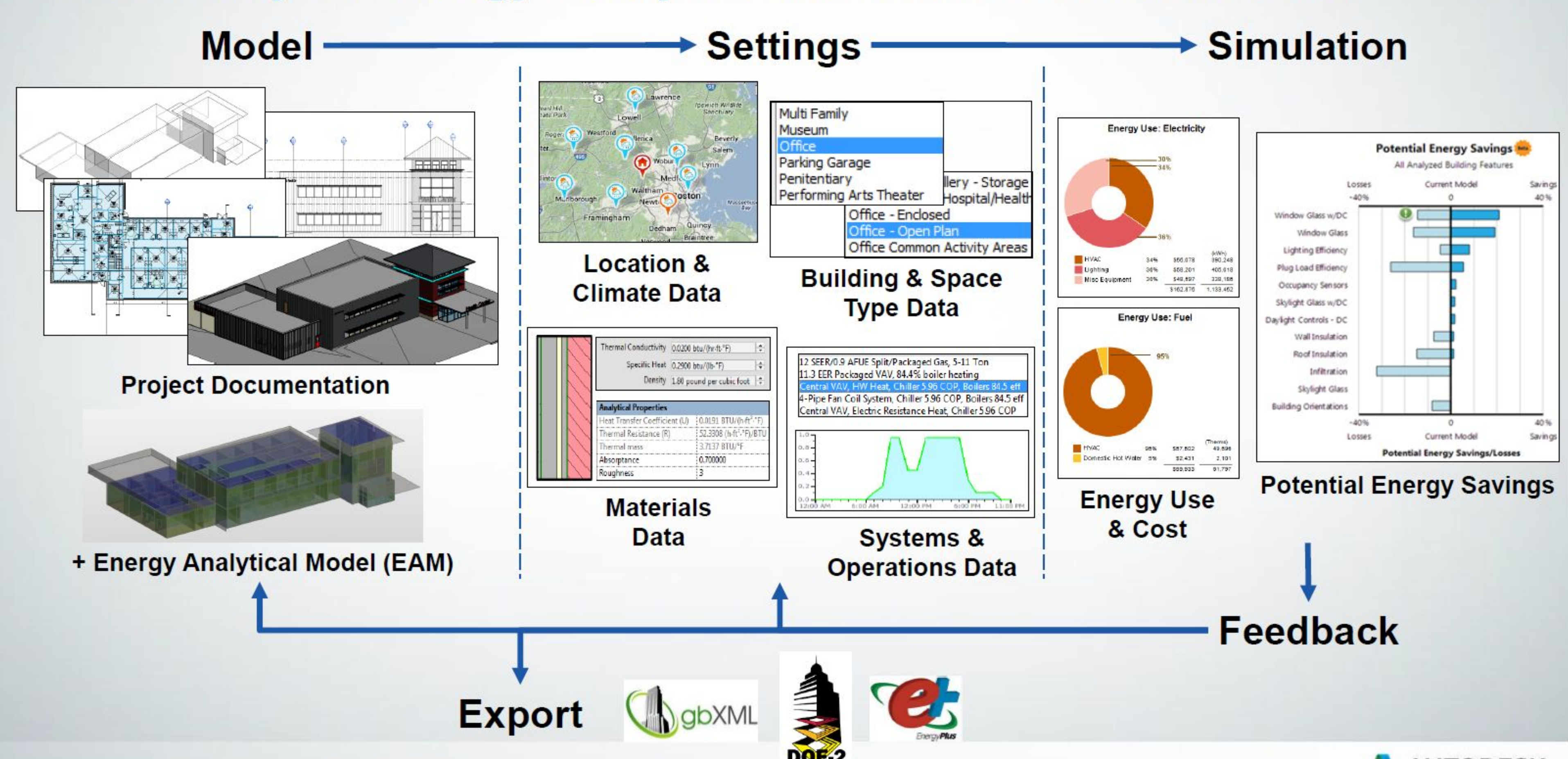
Climate, Solar & Airflow



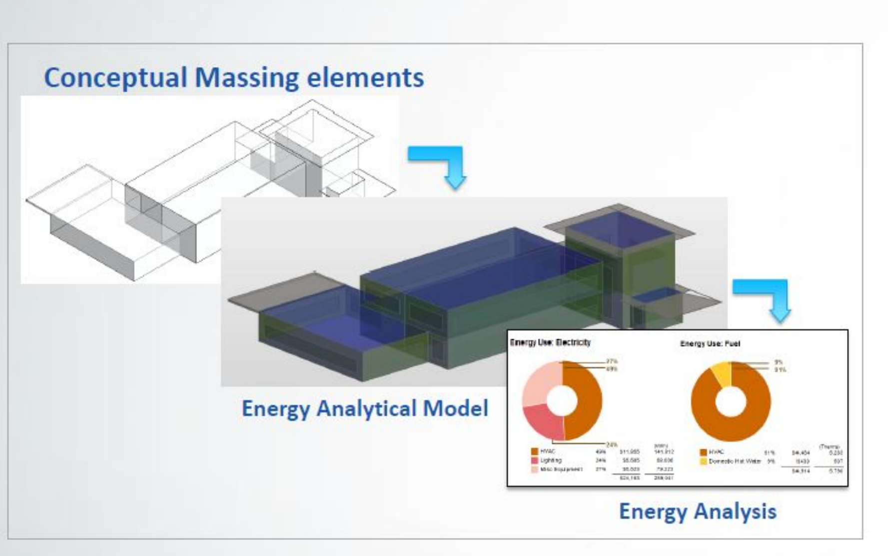


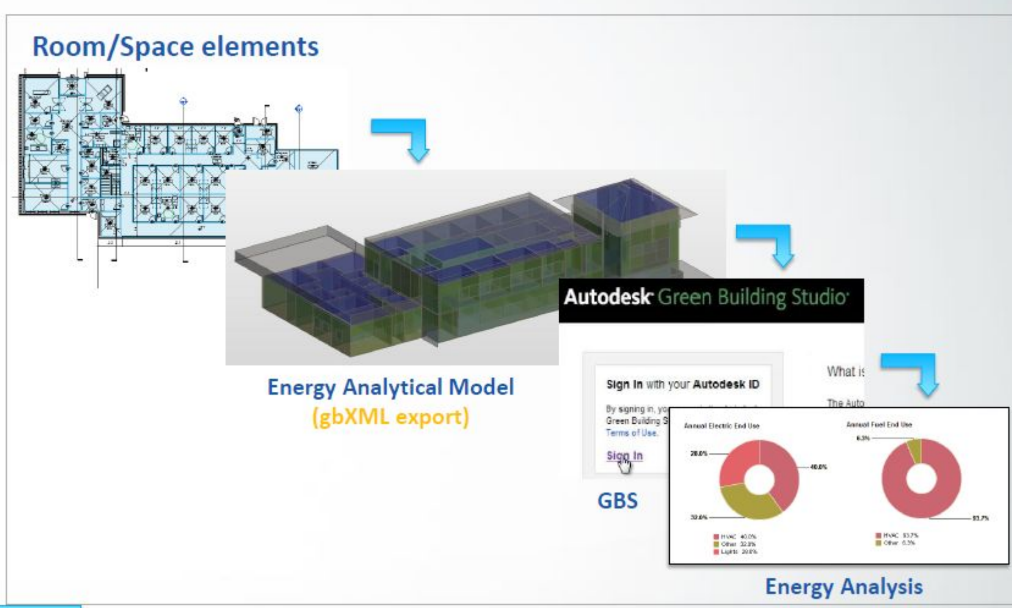


Climate Server 'Ecotect' features


Summary of Energy Analysis information & workflow…
Model
Settings
Simulation
Project Documentation
+ Energy Analytical Model (EAM)
Location & Climate Data
Multi Family
Museum
Office
Parking Garage
Penitentiary
Performing Arts Theater
Office - Enclosed
Office - Open Plan
Office Common Activity Areas
Building & Space Type Data
Materials Data
12 SEER/0.9 AFUE Split/Packaged Gas, 5-11 Ton
11.3 EER Packaged VAV, 84.4% boiler heating
Central VAV, HW Heat, Chiller 5.96 COP, Boilers 84.5 eff
4-Pipe Fan Coil System, Chiller 5.96 COP, Boilers 84.5 eff
Central VAV, Electric Resistance Heat, Chiller 5.96 COP
Systems & Operations Data
Energy Use: Electricity
Energy Use: Fuel
Energy Use & Cost
Potential Energy Savings
Feedback
Export
gbXML
DOE-2
EnergyPlus

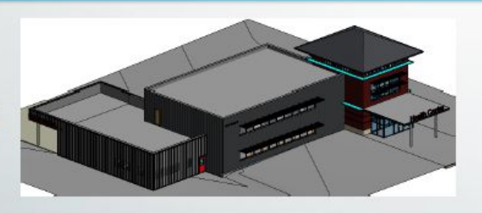
Revit Energy Analysis Features & Workflows…



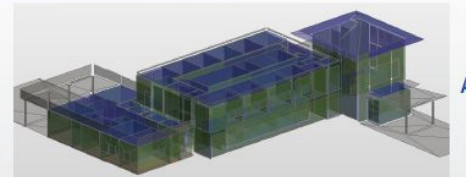


Typically fastest and most reliable with 'real' architectural Revit models

Building elements

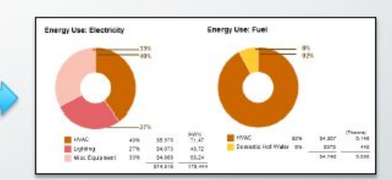






Energy Analytical Model





Energy Analysis

Sustainable Construction and Buildings

1. Buildings use 46% of all energy – up to 70% in major cities
2. Construction uses 53% of primary materials
3. Construction has second biggest environmental footprint after food
4. 13 million tonnes of materials delivered and not used
5. 90 million tonnes of waste – 3 times domestic output
6. 21% of all hazardous waste in UK is construction waste
7. 92% of clients said that designers' drawings are typically not sufficient for construction
8. 37% of materials used in construction become waste
9. 10% of the cost of a project is typically due to change orders
10. 38% of carbon emissions are from buildings not cars

Why accept this ?........

CMAA Owners survey 2005, CMAA Industry Report 2007, Economist Magazine 2002
Buildings contribute 40% of global carbon emissions.

The UK government's Construction 2025 strategy targets a 33% reduction in the whole-life cost of built assets and a 50% reduction in greenhouse gas emissions by 2025.

This is a stepping stone on the way to the target of cutting emissions by 80% by 2050 (compared with 1990 levels).

Green buildings

- Buildings or homes that are more energy efficient, produce less waste and are healthier to be inside
- Buildings around the globe consume about 48% of the total electricity produced.
- Need of Green Buildings to decrease the demand.
- Typical Problems in Construction Industry Energy Consumption by Buildings

Benefits of Green Building



- **Environmental benefits:**
  - Enhance and protect ecosystems
  - Improve air and water quality
  - Reduce solid waste
  - Conserve natural resources

- **Economic benefits:**
  - Reduce operating costs
  - Enhance asset value and profits
  - Improve employee productivity and satisfaction
  - Optimize life-cycle economic performance

- **Health and community benefits:**
  - Improve air, thermal, and acoustic environments
  - Enhance occupant comfort and health
  - Minimize strain on local infrastructure
  - Contribute to overall quality of life

Sustainable Design



Energy

Lighting and equipment

Heating, cooling, and ventilation

Occupant processes



- Minimize operating energy
- Utilize renewable energy
- Select and design site



Water

Potable supply for occupants

Non-potable supply for processes

Storm water runoff



- Reduce water use
- Reclaim gray water
- Manage Hydraulics and Hydrology (H&H)

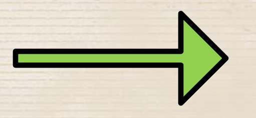


Materials

Site work

Structure, envelope, and finishes

Furnishings and equipment



- Implement low impact development
- Seek renewable sources
- Minimize embodied measures

sustainability
credit categories

Innovation & Design

Location & Linkages

Sustainable Sites

Water Efficiency

Energy & Atmosphere

Materials & Resources

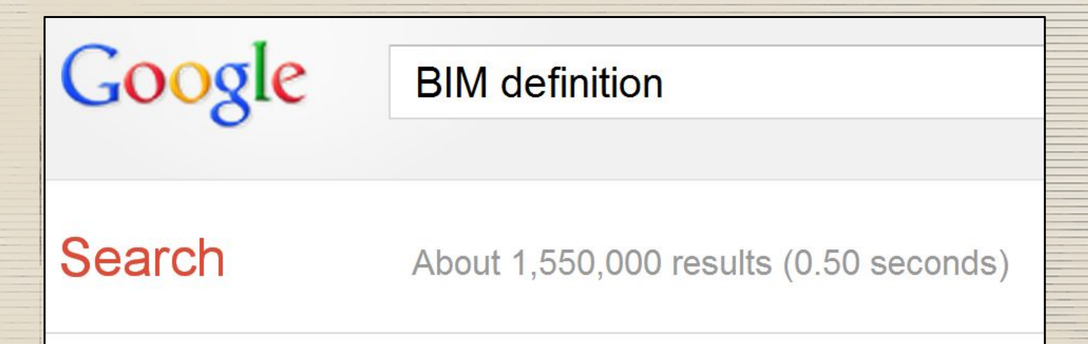
Indoor Environmental Quality

Awareness & Education

What is BIM?

Building Information Modeling
Building Information Management

Better Information For Management.



“is a process supported by different tools, technologies and contracts involving the generation and management of a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward.”

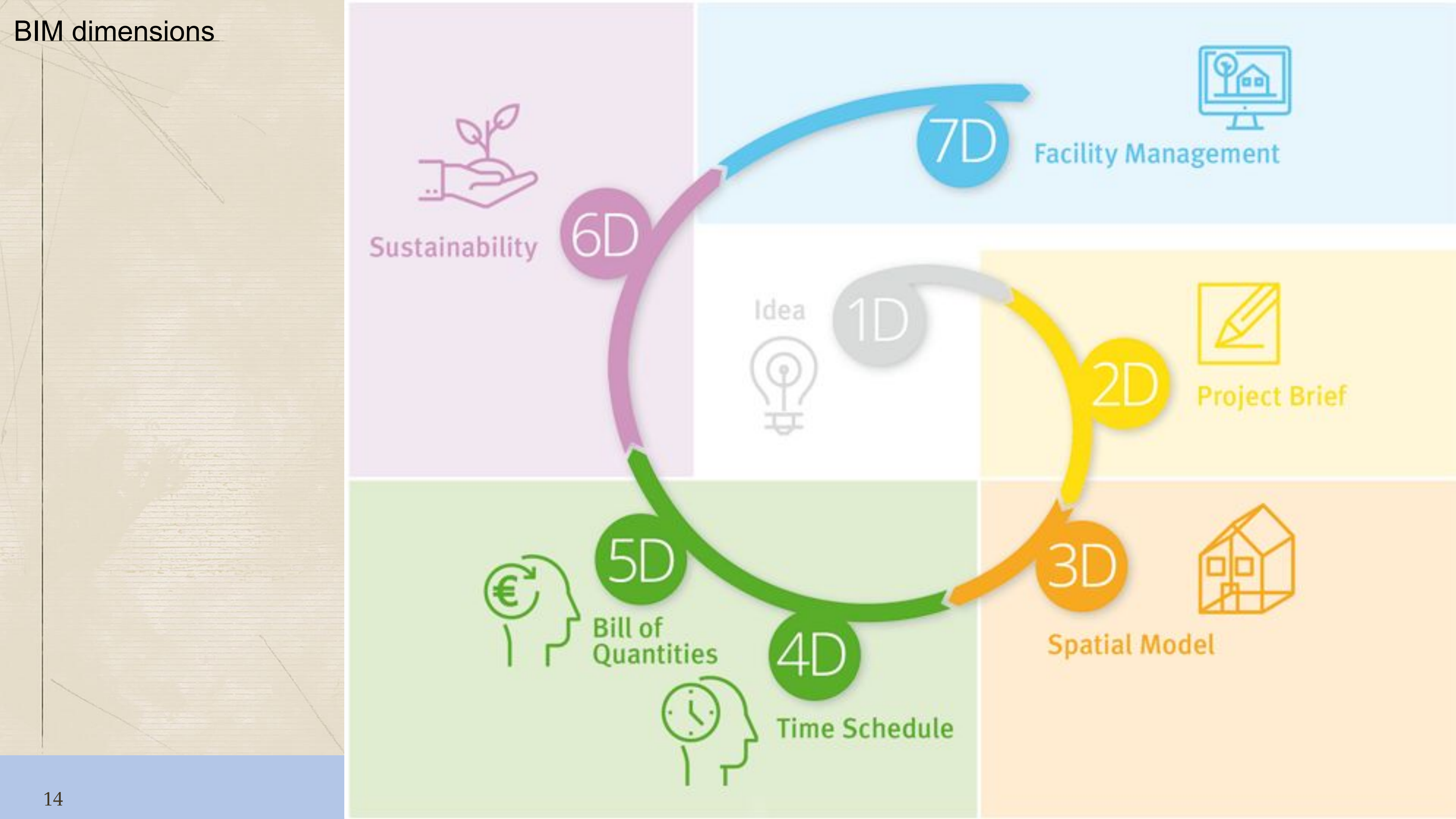
WHY BIM ,,Benefits of BIM,,

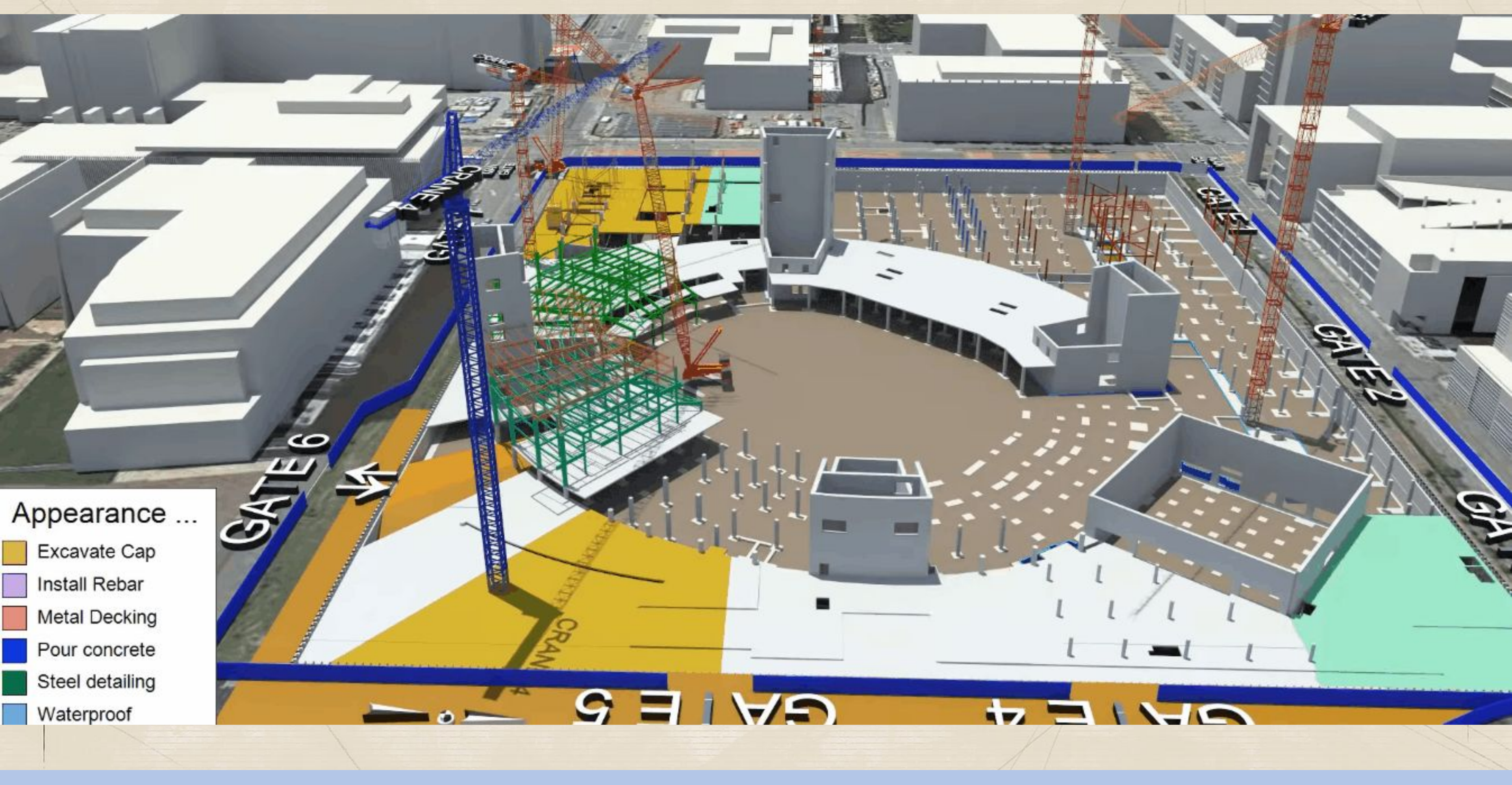
What is the added value that BIM can provide to sustainability ?

- Decision making
- Rating compliance
- Building Performance
- 3d visual information
- Numerical information
- Data linking transfer
- REM : Rapid Energy Modelling
- Analysis
- Cloud computing

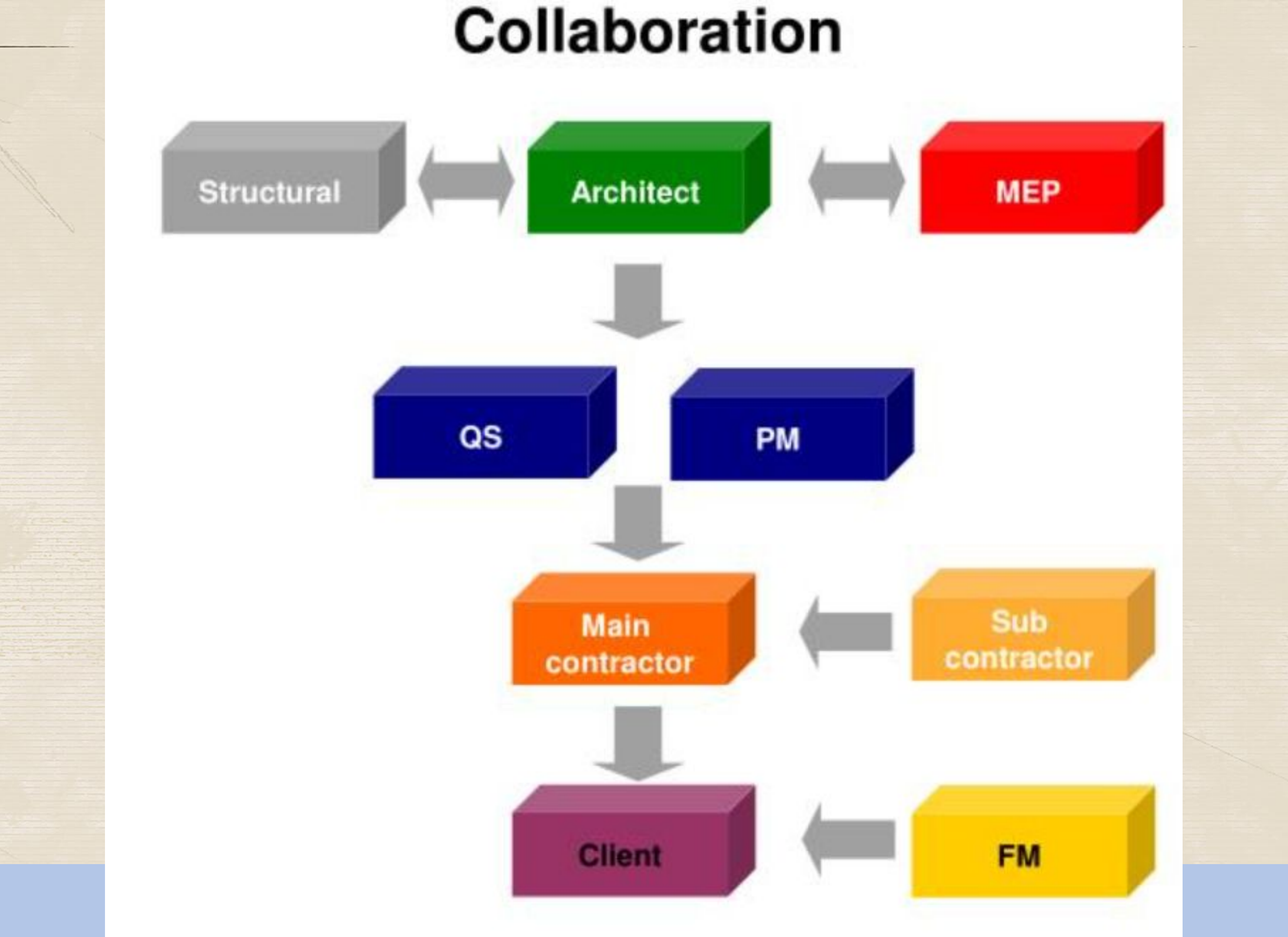
- Building location
- Building orientation
- Water use reduction
- Outdoor air delivery monitoring
- Increased ventilation
- Thermal comfort

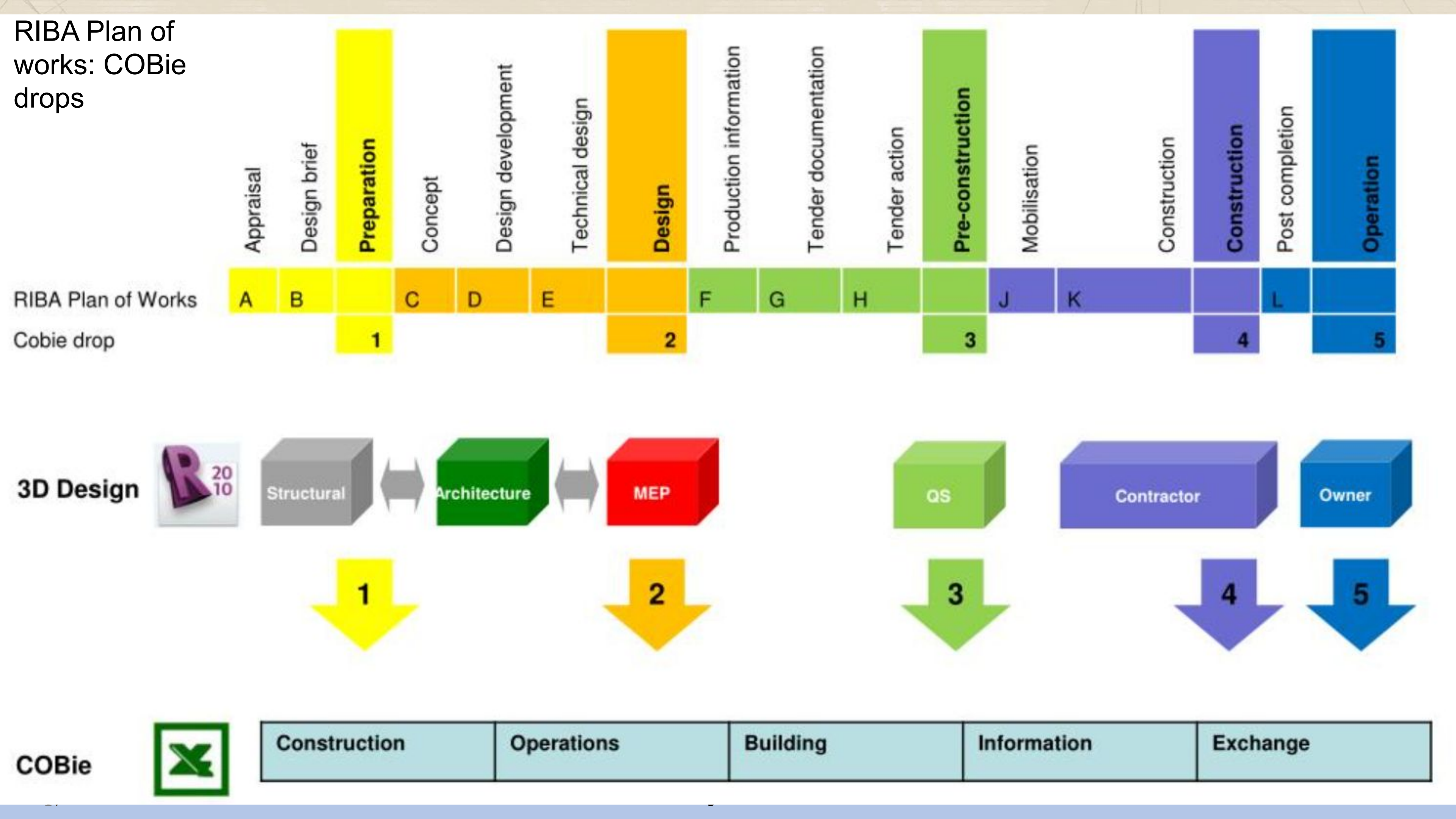



BIM dimensions
7D
Facility Management
6D
Sustainability
1D
Idea
2D
Project Brief
3D
Spatial Model
4D
Time Schedule
5D
Bill of
Quantities
€
14


Appearance ...
Excavate Cap
Install Rebar
Metal Decking
Pour concrete
Steel detailing
Waterproof
CRANE 4
GATE 1
GATE 2
GATE 4
GATE 5
GATE 6

Way to BIM


Collaboration
Structural
Architect
MEP
QS
PM
Main contractor
Sub contractor
Client
FM


RIBA Plan of works: COBie drops
Appraisal
Design brief
Preparation
Concept
Design development
Technical design
Design
Production information
Tender documentation
Tender action
Pre-construction
Mobilisation
Construction
Construction
Post completion
Operation
RIBA Plan of Works
A
B
C
D
E
F
G
H
J
K
L
Cobie drop
1
2
3
4
5
3D Design
20
10
Structural
Architecture
MEP
QS
Contractor
Owner
1
2
3
4
5
COBie
Construction
Operations
Building
Information
Exchange





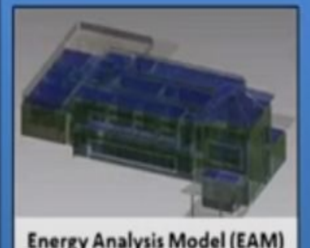
- Visualization
- Structural analysis
- Cost
- Documentation
- Fabrication/Construction
- Etc...

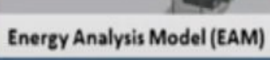


Building Performance Analysis (BPA)

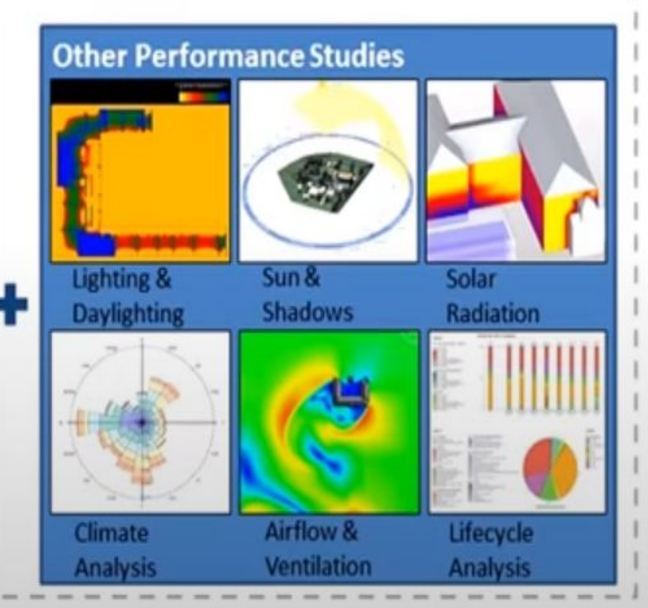
Whole Building Energy Analysis

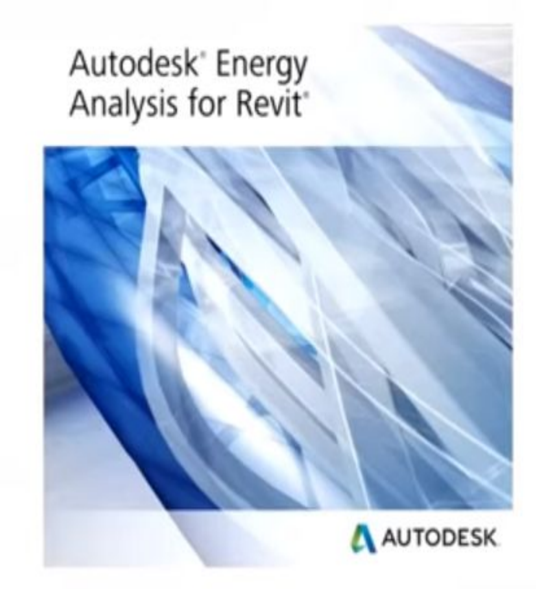
- Conceptual Models
- Detailed Models







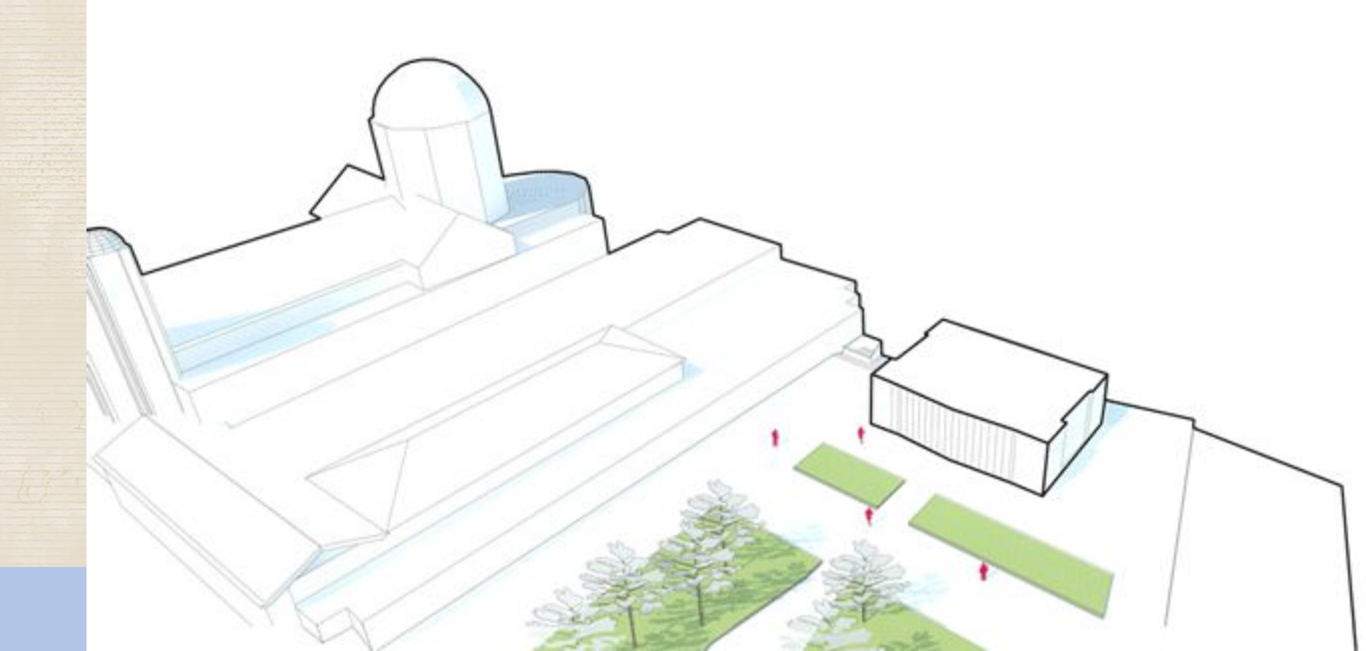


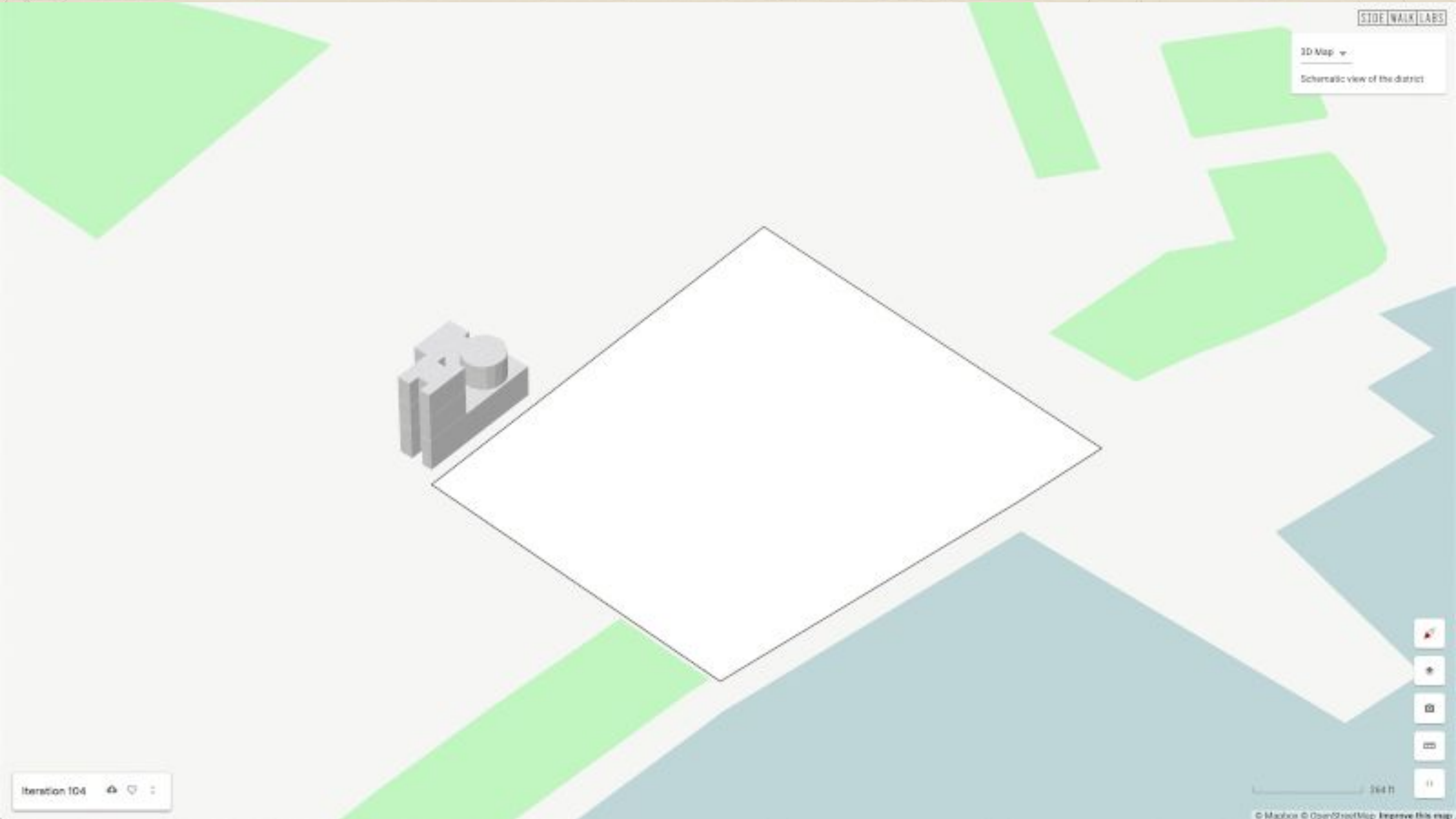


- Performance-based Design Studies


BIM
0
intersections
250 rays cast
37 33
81
79

BIM Model

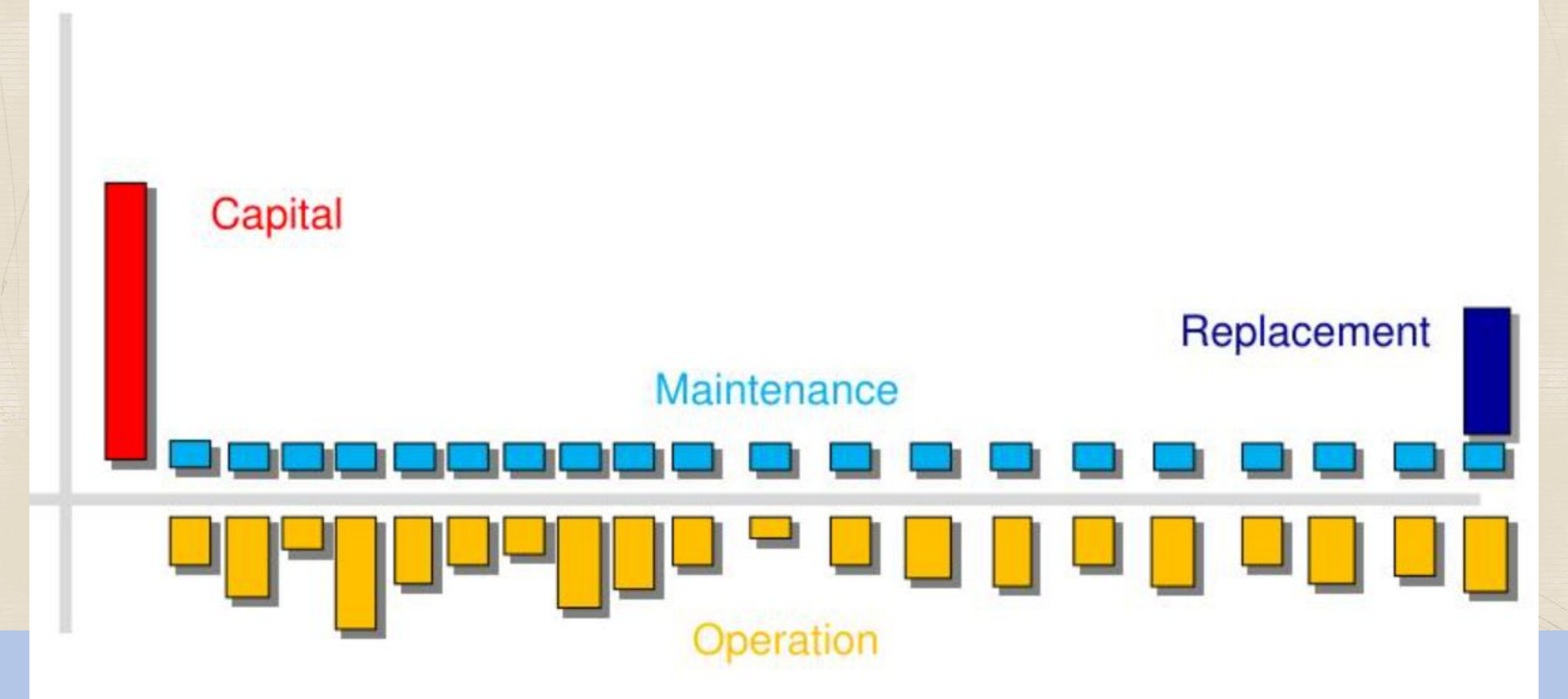



SIDE WALK LABS
3D Map
Schematic view of the district
Iteration 104




Massing studies with Levels for area analysis and Solar Analysis for quick solar impact studies
More stylistic rendering that you can achieve with Monotone surfaces, ambient and traditional shadows, extended edges, and lower contrast lines
Traditional realistic materials and entourage which creates a compelling presentation image for conceptual design phase

Life cycle cost





Building Cost

Design	Build	Operate	Dispose	Total
3%	17%	Run/Maintain 40%	?%	100% Cost of Ownership
		Repair 30%		
		Periodic Replacement/ Refurbishment 10%		
1Year	2 Years	25 Years	1 Year	Total

Ref. Tumer and Townsend, Construction and Management Consultants

Why BIM ,,Benefits of BIM,,

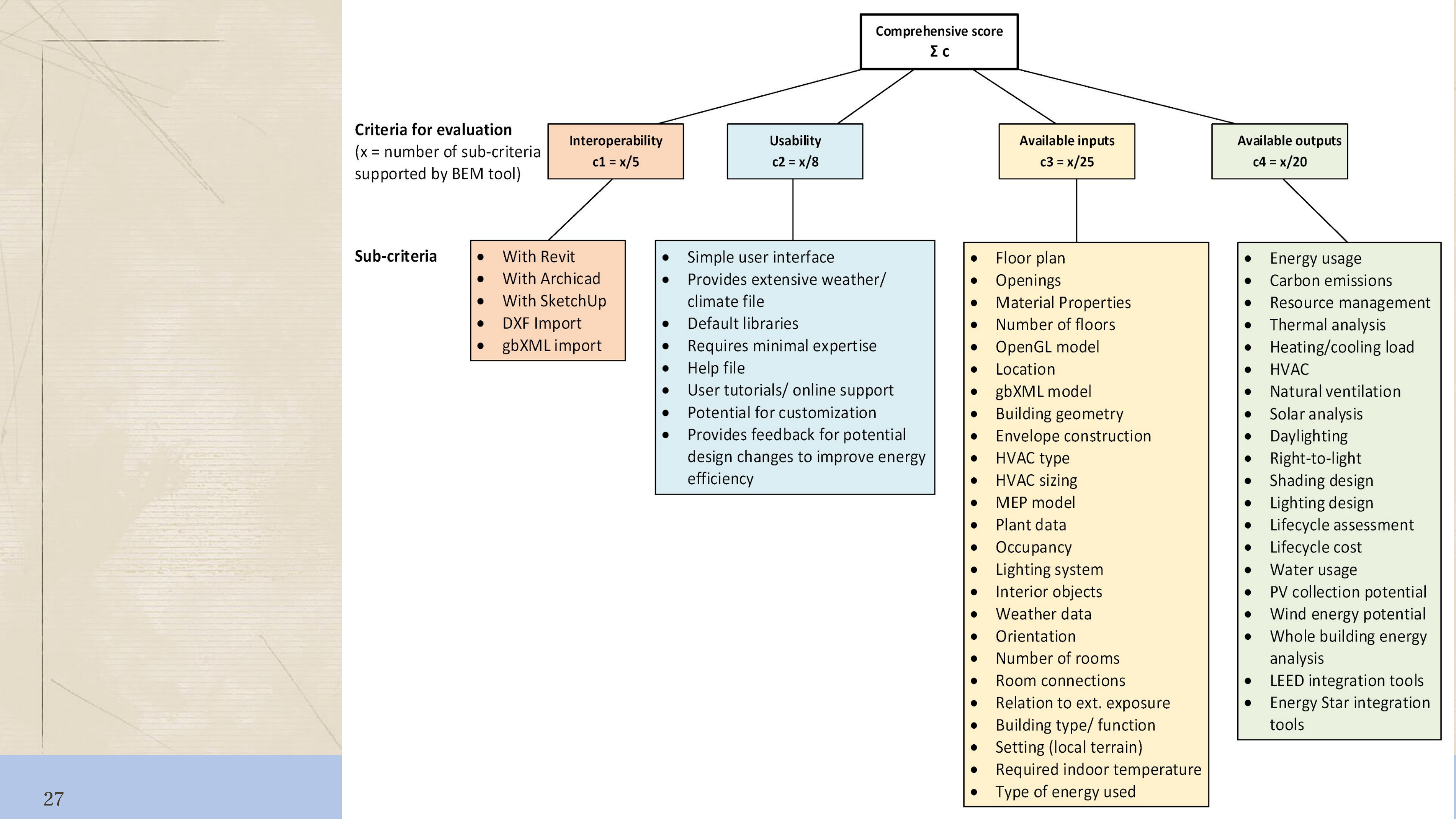
The color of BIM is green.

Sustainability can be defined as the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs.

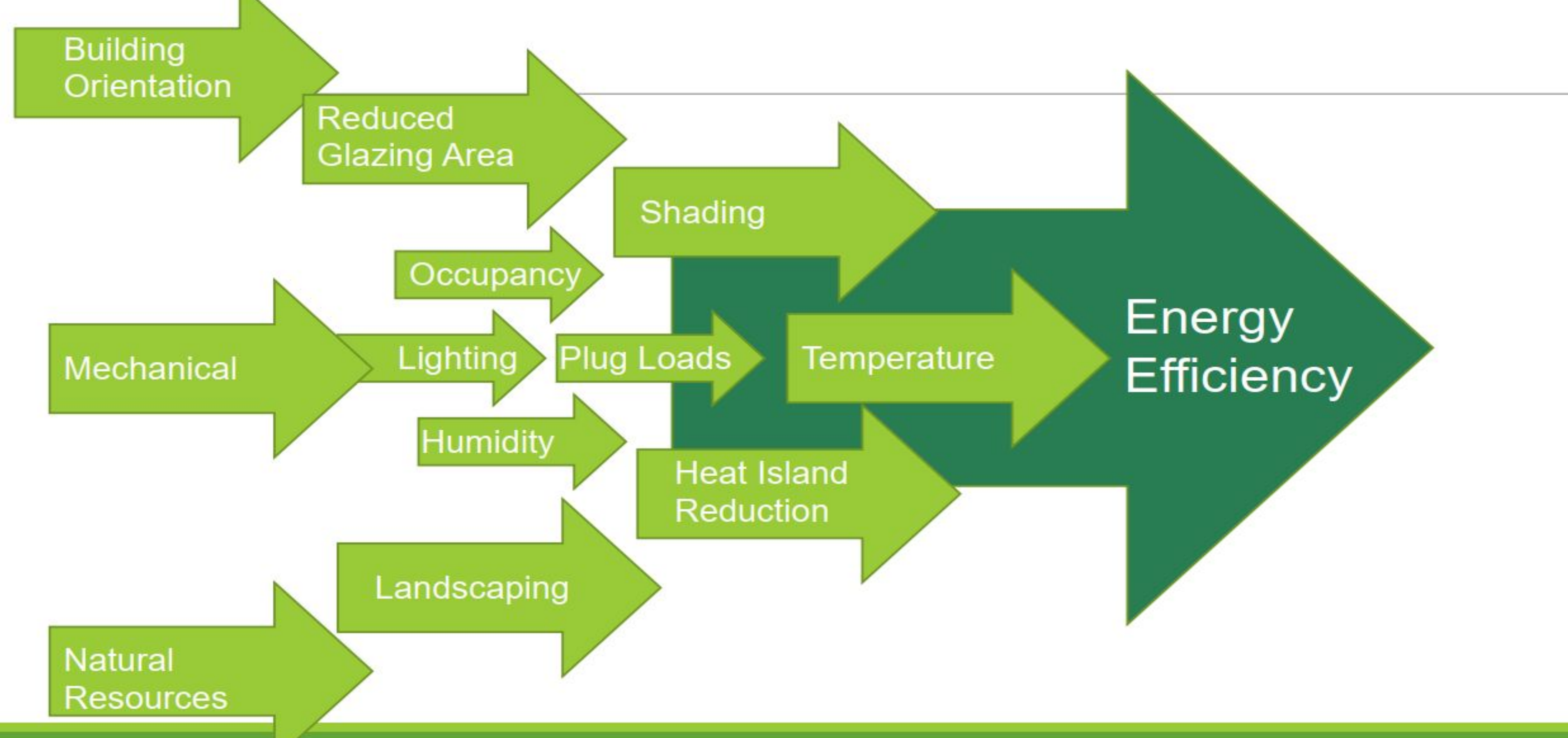
“Sustainability begins with really understanding **how you will use a building.**

BIM lets you model the space and run analytics so you can make sure the building will efficiently support the people who use it.”

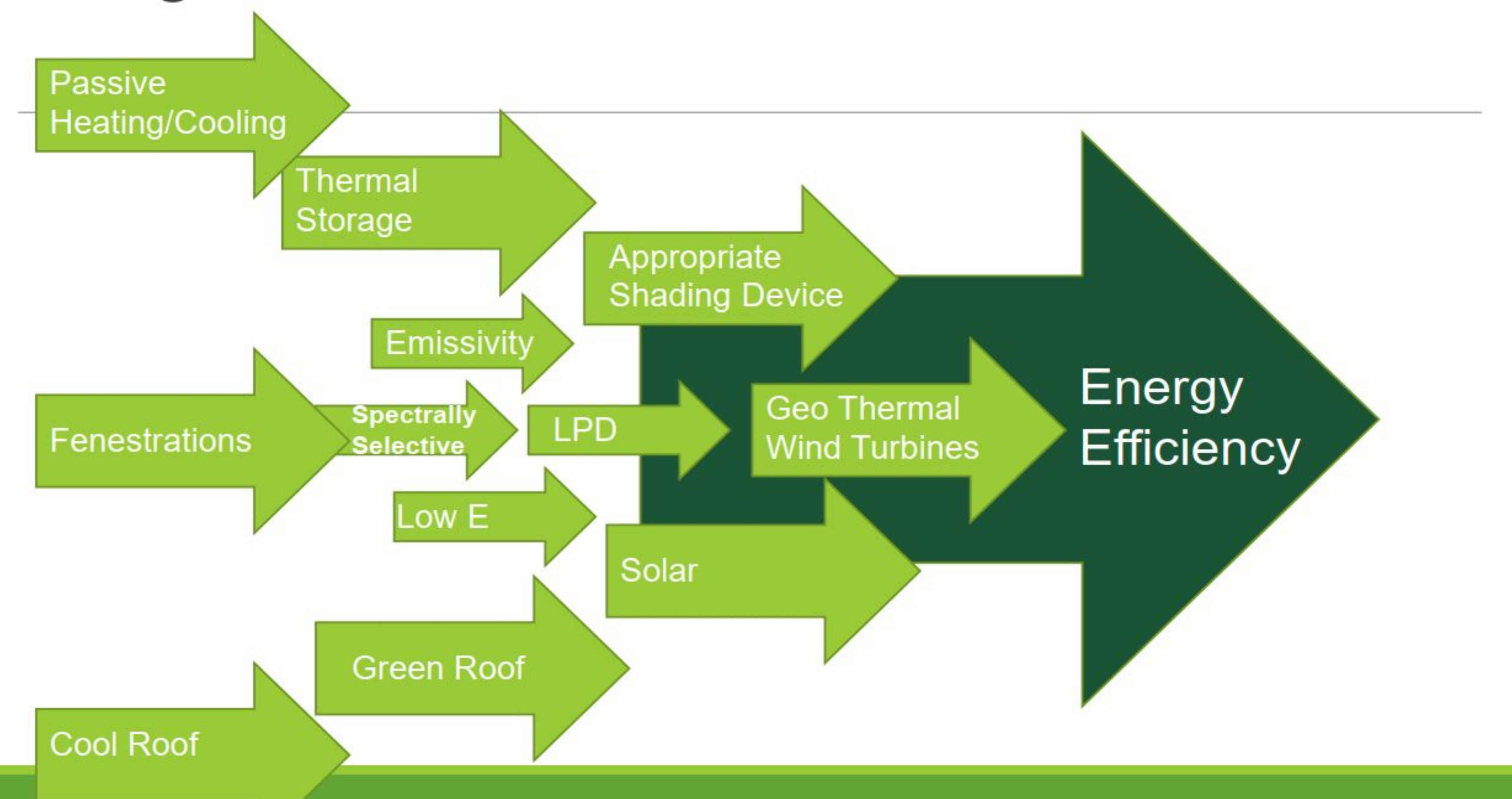



Comprehensive score
Σ c
Criteria for evaluation
(x = number of sub-criteria supported by BEM tool)
Interoperability
c1 = x/5
Usability
c2 = x/8
Available inputs
c3 = x/25
Available outputs
c4 = x/20
Sub-criteria
With Revit
With Archicad
With SketchUp
DXF Import
gbXML import
Simple user interface
Provides extensive weather/ climate file
Default libraries
Requires minimal expertise
Help file
User tutorials/ online support
Potential for customization
Provides feedback for potential design changes to improve energy efficiency
Floor plan
Openings
Material Properties
Number of floors
OpenGL model
Location
gbXML model
Building geometry
Envelope construction
HVAC type
HVAC sizing
MEP model
Plant data
Occupancy
Lighting system
Interior objects
Weather data
Orientation
Number of rooms
Room connections
Relation to ext. exposure
Building type/ function
Setting (local terrain)
Required indoor temperature
Type of energy used
Energy usage
Carbon emissions
Resource management
Thermal analysis
Heating/cooling load
HVAC
Natural ventilation
Solar analysis
Daylighting
Right-to-light
Shading design
Lighting design
Lifecycle assessment
Lifecycle cost
Water usage
PV collection potential
Wind energy potential
Whole building energy analysis
LEED integration tools
Energy Star integration tools

Building Performance Simulation – Basics



Building Performance Simulation – Advanced



Weather Data

Design Conditions

– ASHRAE Handbook of Fundamentals

• Weather Statistics & Observations

– National Climatic Data Center (U.S.)

– Mesowest (Southwest U.S.)

– Weather Bank (International)

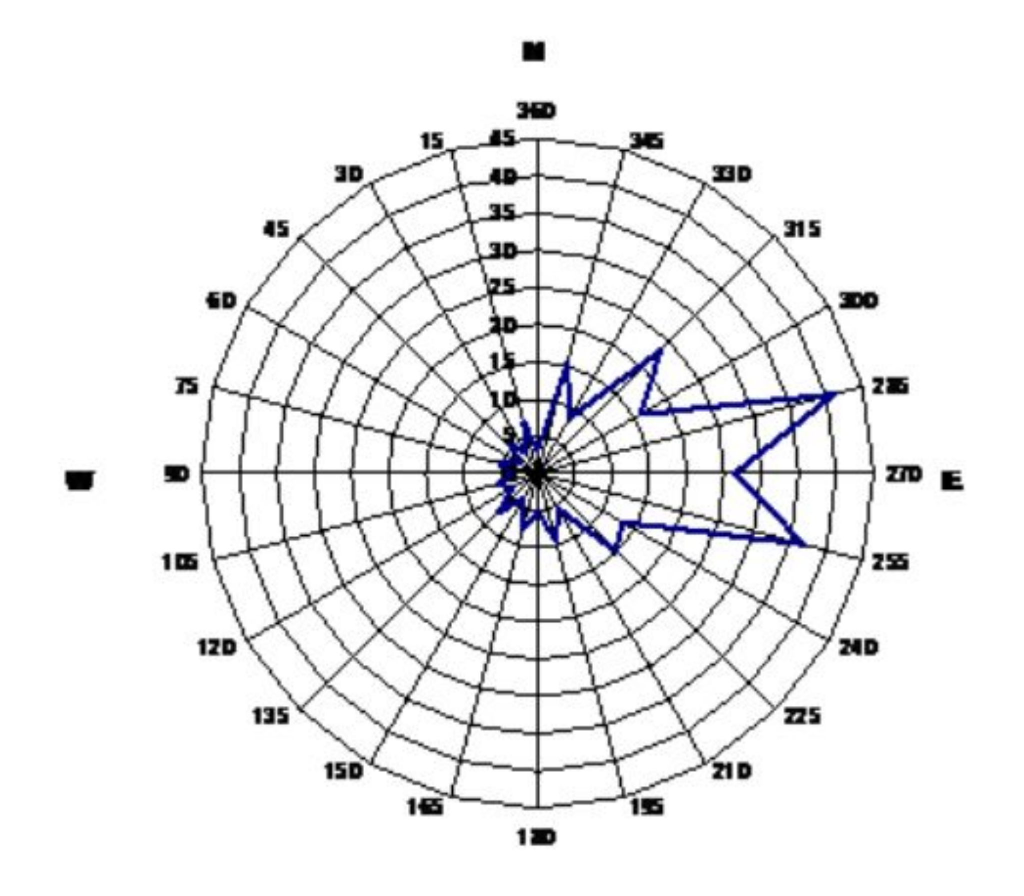
• Annual Weather Data

– DOE-2 Website (TMY, WYEC, etc)

– EnergyPlus Website (EPW, CSV)

• International Weather Data

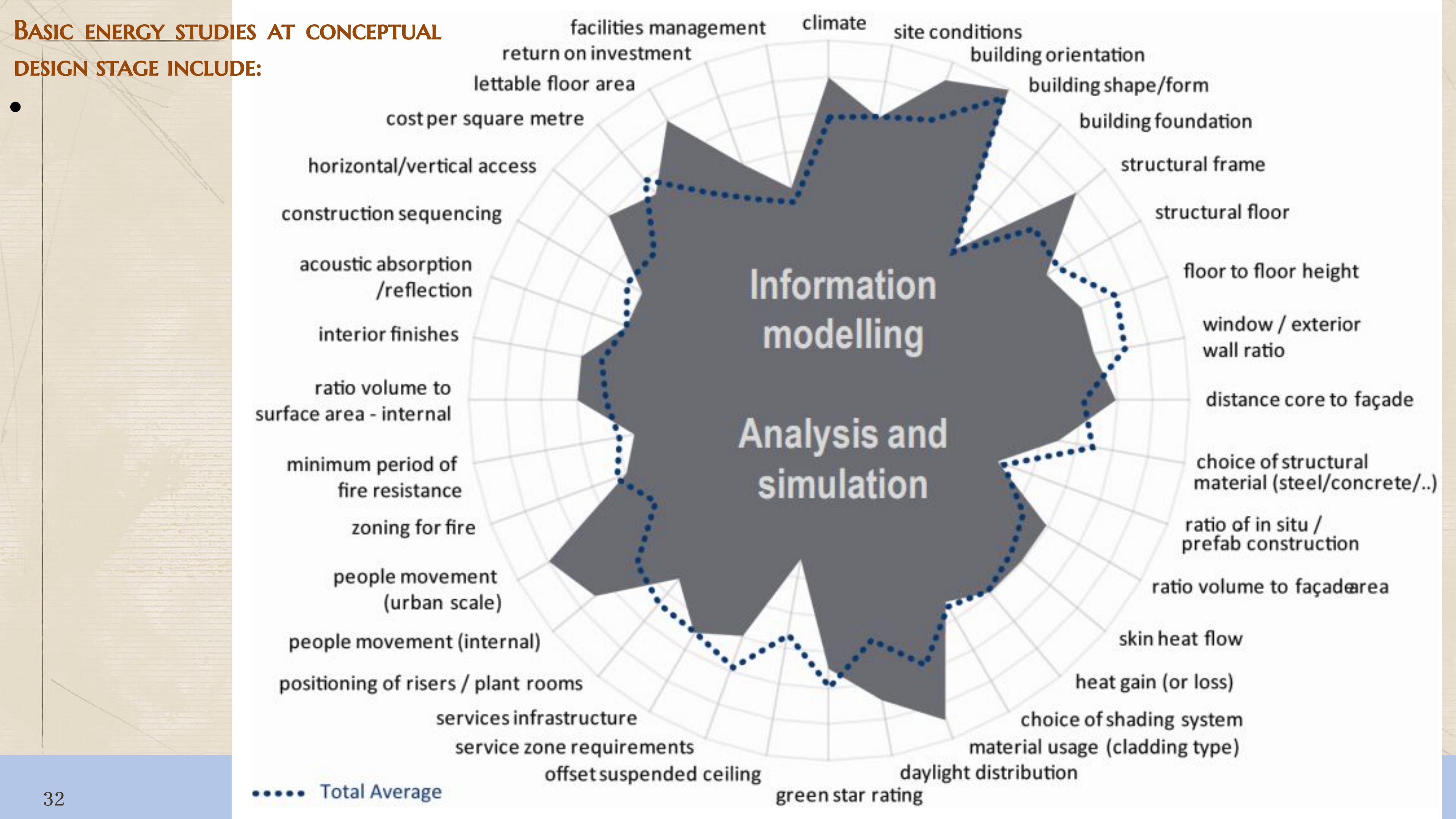
– EnergyPlus Weather Source Data



Weather Data

A weather data layer for Google Earth on the US EERE weather file site shows EnergyPlus weather file locations. This allows a designer to compare nearby weather files for the best site match, accounting for any change in elevation, proximity to mountains or water bodies, as shown in Case Study 5.3. Google Earth images use data from SIO, NOAA, the U.S. Navy, NGA, GEBCO, Cnes Spot Image, Terrametrics, and IBCAO





Basic energy studies at conceptual design stage include:
•
facilities management
climate
site conditions
return on investment
building orientation
lettable floor area
building shape/form
cost per square metre
building foundation
horizontal/vertical access
structural frame
construction sequencing
structural floor
acoustic absorption /reflection
floor to floor height
interior finishes
window / exterior wall ratio
ratio volume to surface area - internal
distance core to façade
Information modelling
Analysis and simulation
minimum period of fire resistance
choice of structural material (steel/concrete/..)
zoning for fire
ratio of in situ / prefab construction
people movement (urban scale)
ratio volume to façade area
people movement (internal)
skin heat flow
positioning of risers / plant rooms
heat gain (or loss)
services infrastructure
choice of shading system
service zone requirements
material usage (cladding type)
offset suspended ceiling
daylight distribution
green star rating
Total Average

Basic energy studies at conceptual design stage include:

Sun and shadow

- Wind / natural ventilation
- Solar loads / radiation
- Building envelope performance
- Heating & Cooling loads
- Daylight availability
- Whole building energy use & costs
- Water use & costs (indoor, outdoor)
- Carbon emissions
    - Lighting analysis
    - CFD analysis
    - Fire analysis
    - Solar/shading analysis
    - Energy code compliance
    - Thermal comfort
    - Heating and cooling load analysis
    - LCA Life Cycle Assessment
    - Renewable energy
    - HVAC equipment sizing

Sustainable Design Simulations Run on Information Models and Databases

XML and IFCs have emerged as sustainable design information modeling standards.

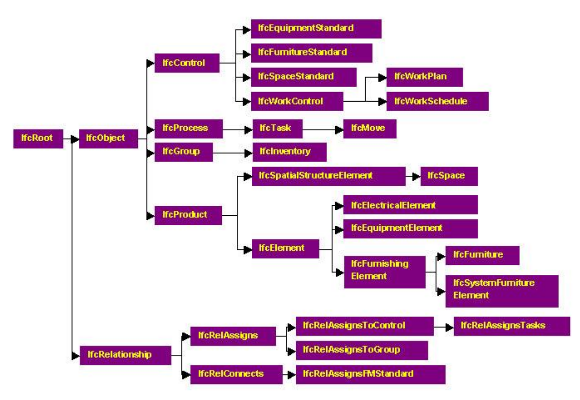
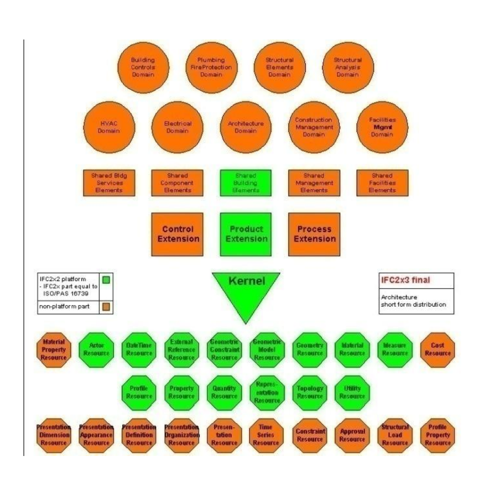


Figure 10: Tracing inheritance structure to IfcRoot



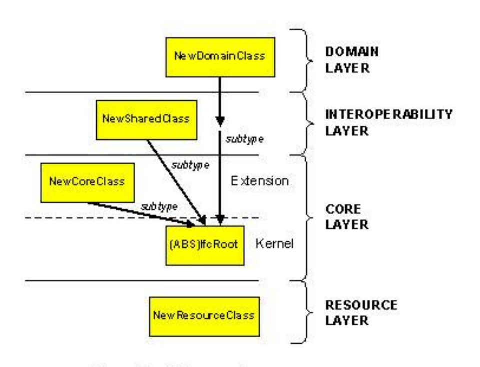
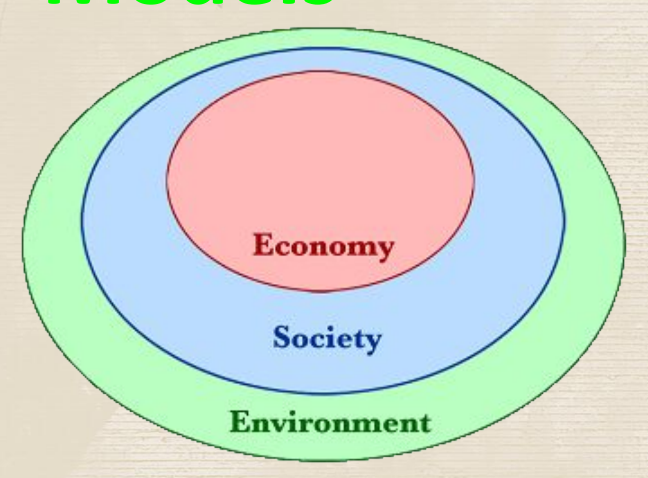
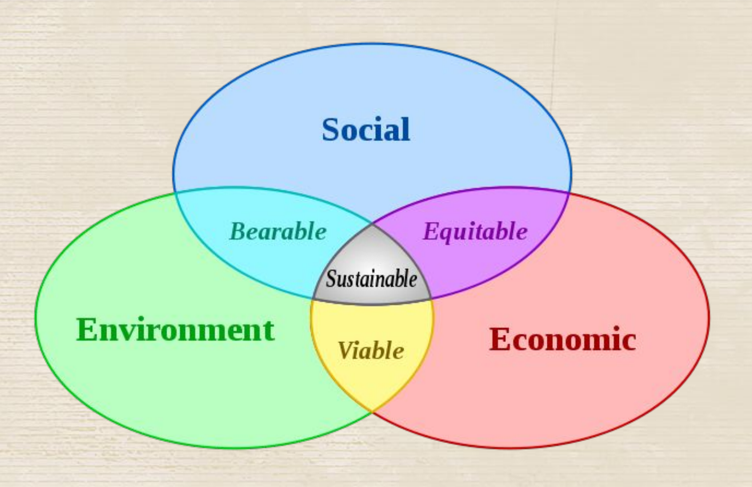


Figure 13: IfcRoot as the common supertype

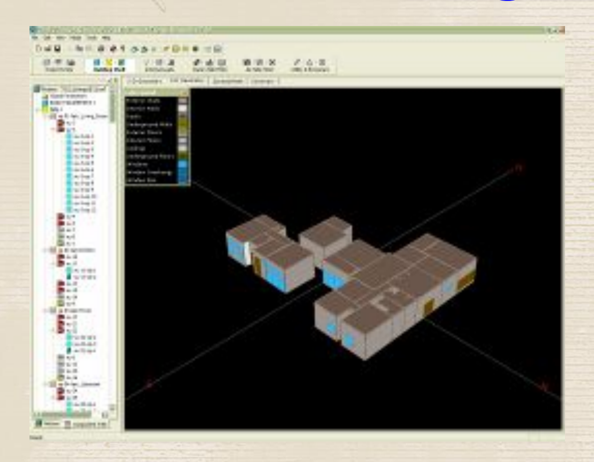
Way to BIM

Sustainability: Graphical Models

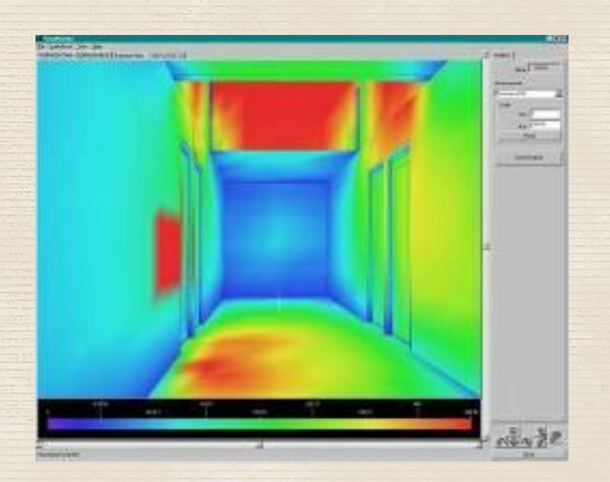




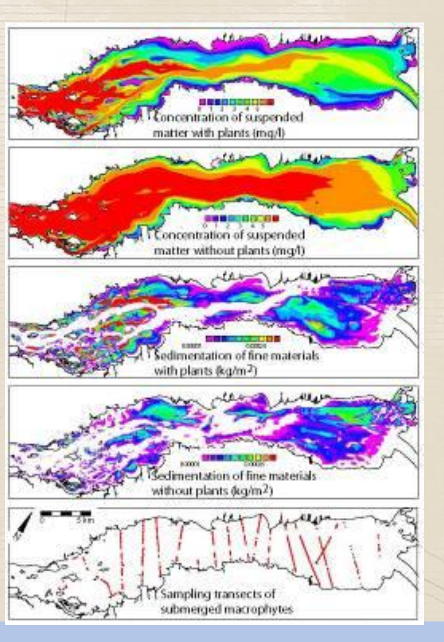
Information Models Enable Sustainable Design Simulations



Educational Campus Building
Energy Use Simulation



Educational Campus Building
Daylighting Simulation



Lake Ecology Simulation

What are the main sustainability challenges that society faces today?

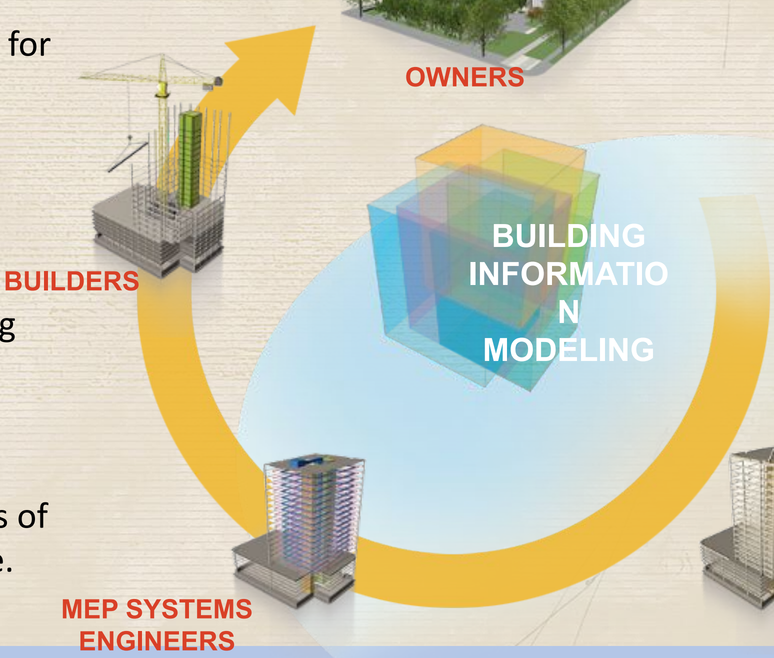
- Mitigating Global Warming and Associated Climate Change While Meeting the Increasing Needs for Energy

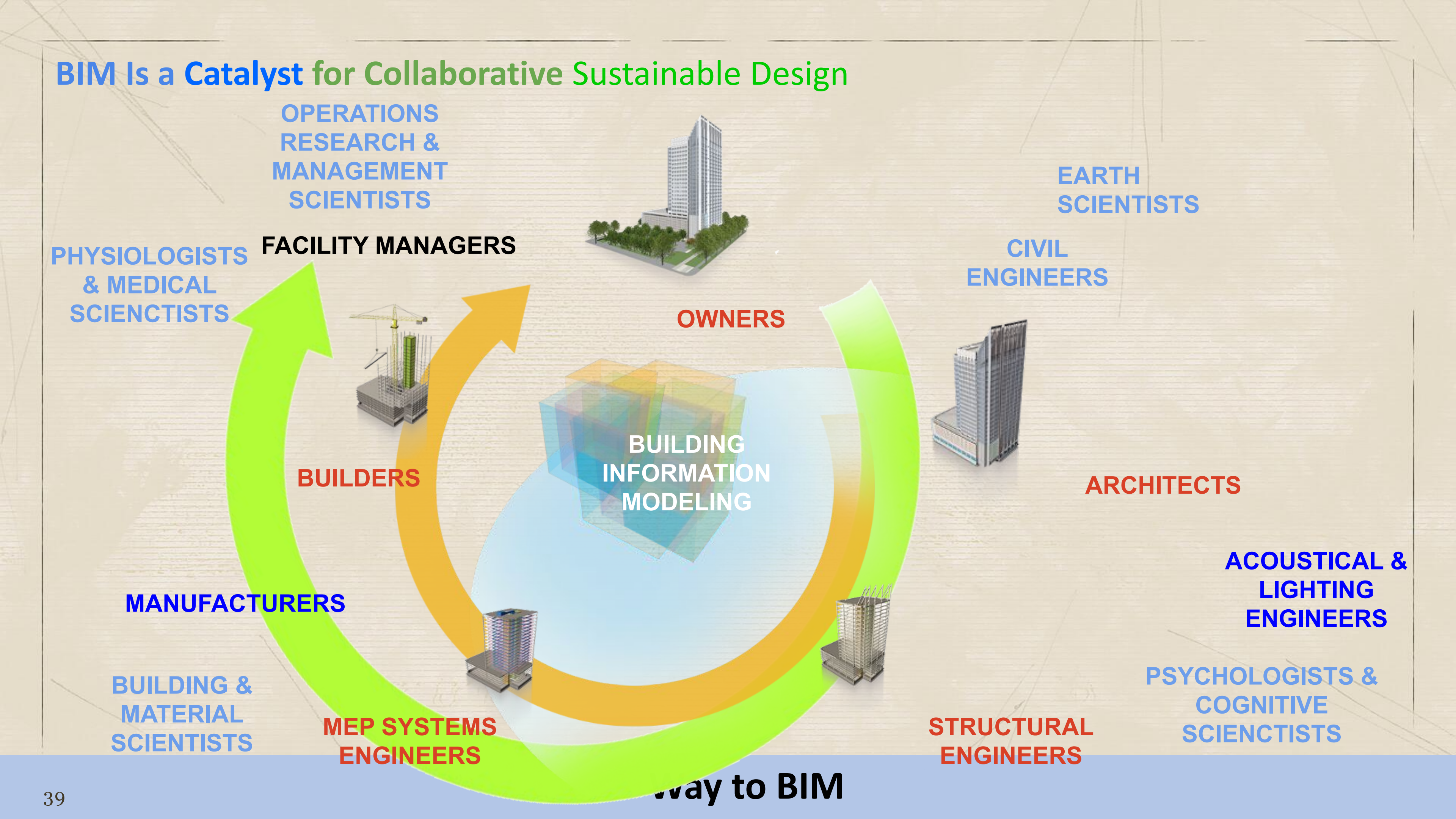
Reversing the Loss of Biodiversity

- Maintaining and Improving Access to Fresh Water
- Maintaining and Improving Access to Healthy and Affordable Food through Sustainable Agriculture
- Maintaining and Expanding Critical Infrastructure that Mitigates Environmental Impacts on Human Health and Improves the Quality of Human Life

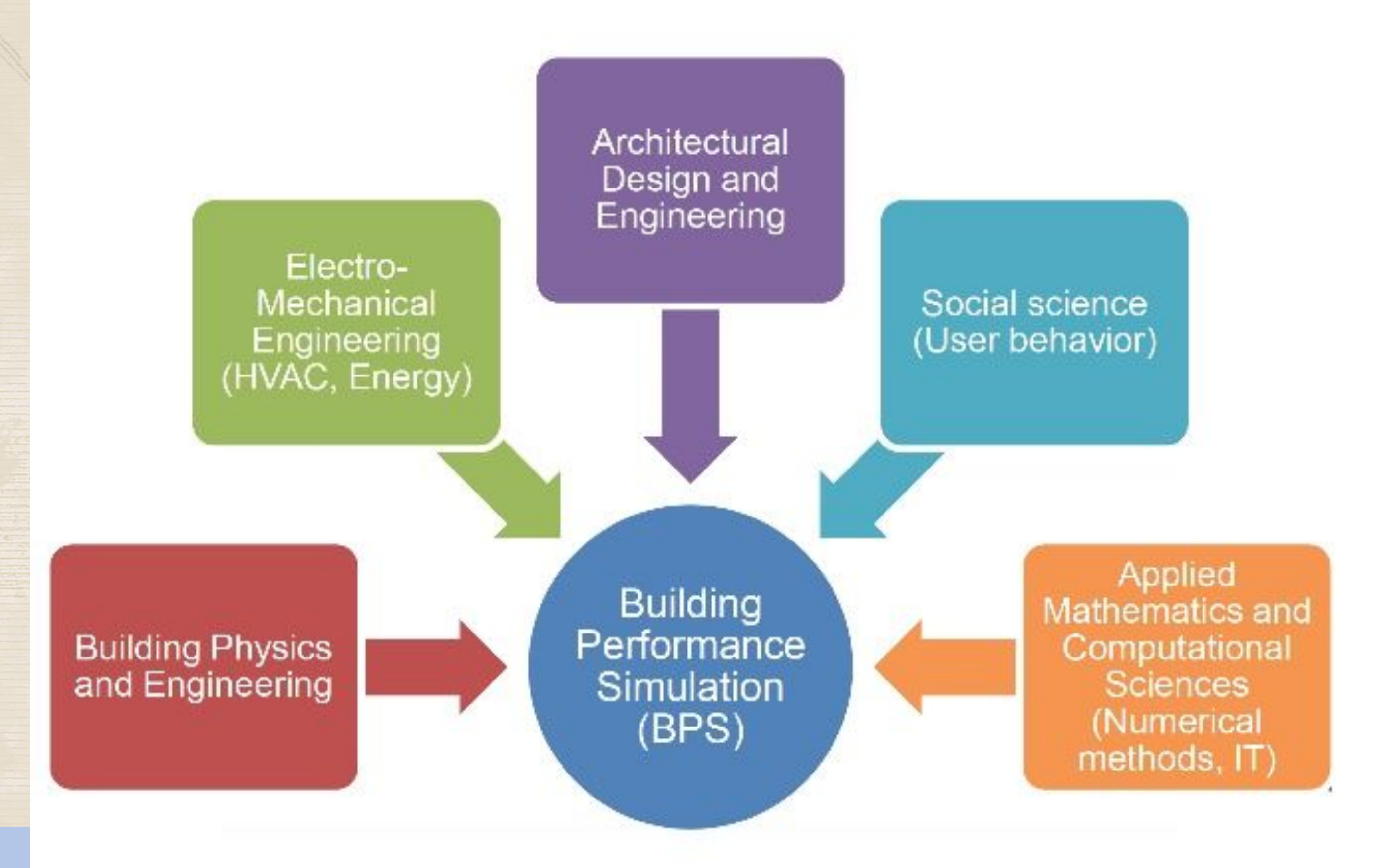
BIM is a Catalyst for Efficient and Effective Sustainable Design

- The most advanced design technology available.
- Makes information available for analysis earlier in design process.
- Supports an improved collaborative process.
- Reduces the effort of increasingly complex building design.
- Facilitates a holistic design approach.
- Enables accurate simulations of building design performance.

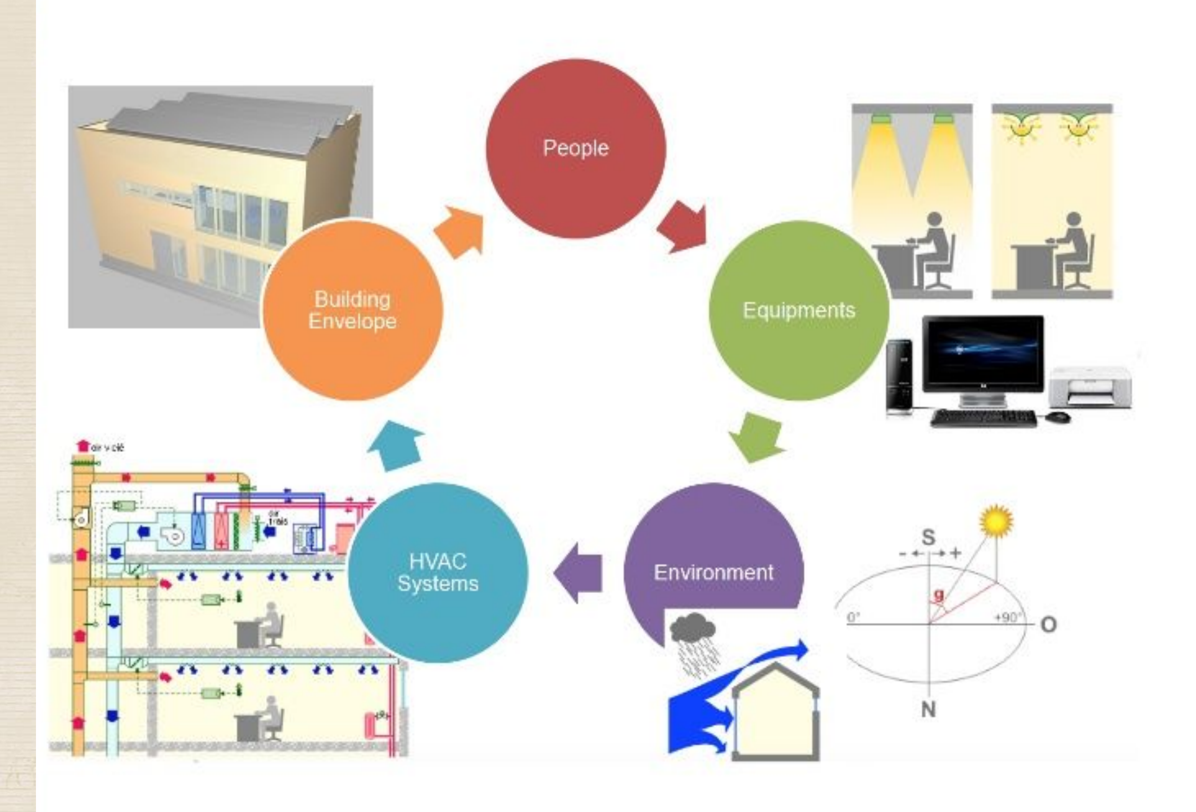


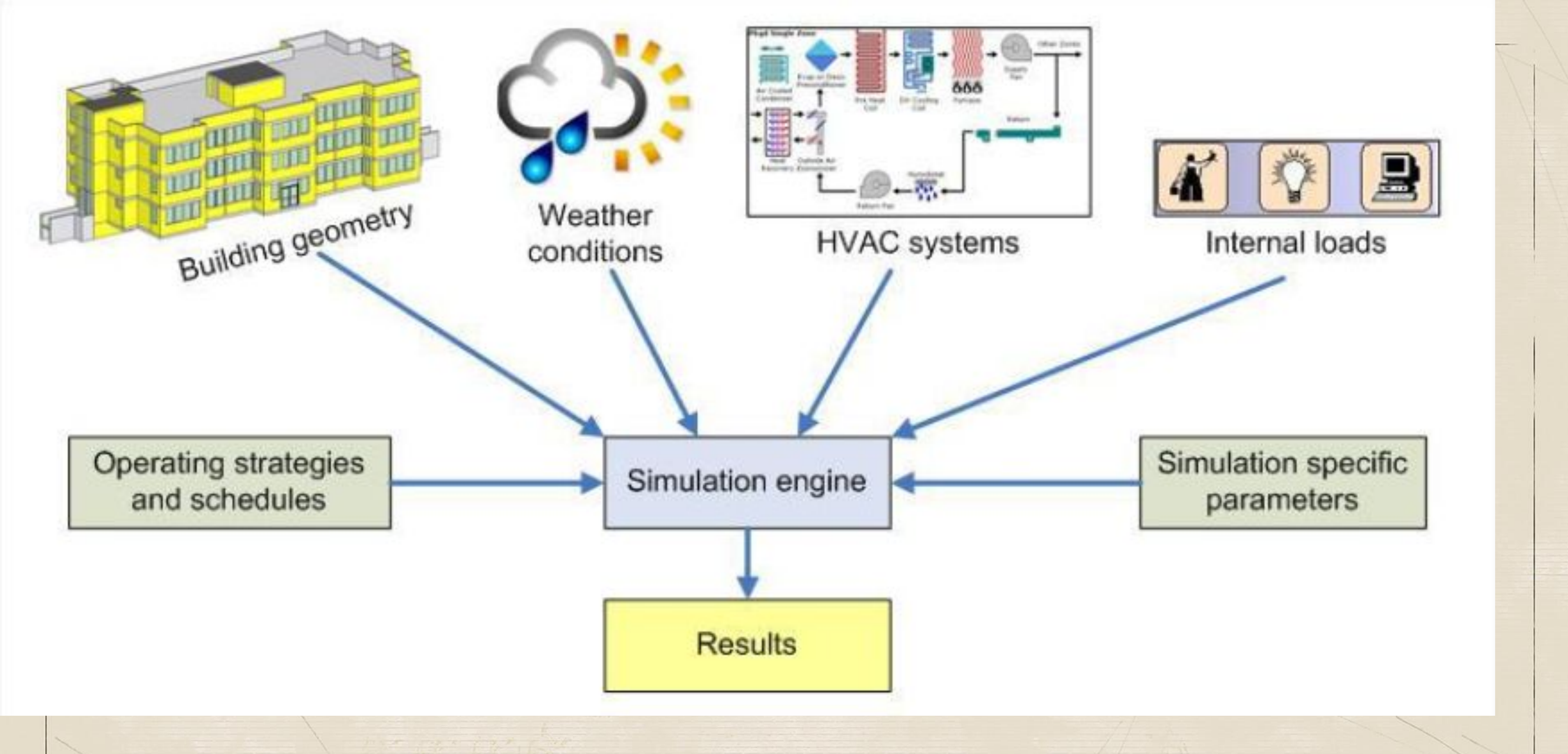

BIM Is a Catalyst for Collaborative Sustainable Design
OPERATIONS RESEARCH & MANAGEMENT SCIENTISTS
FACILITY MANAGERS
PHYSIOLOGISTS & MEDICAL SCIENCTISTS
EARTH SCIENTISTS
CIVIL ENGINEERS
OWNERS
BUILDERS
BUILDING INFORMATION MODELING
ARCHITECTS
ACOUSTICAL & LIGHTING ENGINEERS
MANUFACTURERS
BUILDING & MATERIAL SCIENTISTS
MEP SYSTEMS ENGINEERS
STRUCTURAL ENGINEERS
PSYCHOLOGISTS & COGNITIVE SCIENCTISTS
way to BIM

BPS discipline is multi-disciplinary

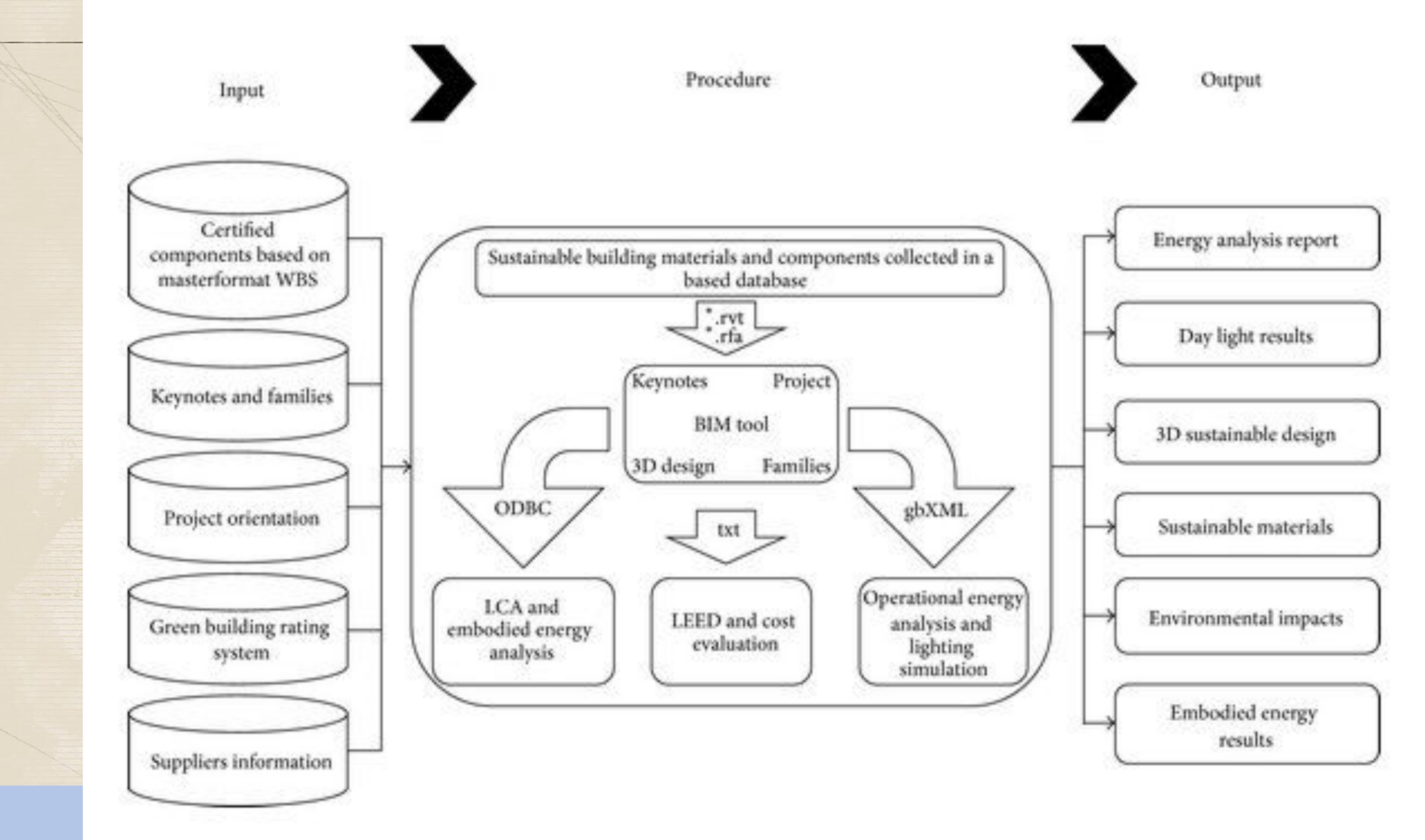


BPS simulates complex coupled systems



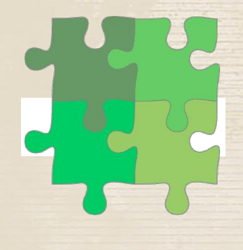

Building geometry
Weather conditions
HVAC systems
Internal loads
Operating strategies and schedules
Simulation engine
Simulation specific parameters
Results

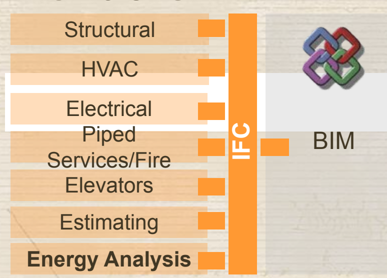
Way to BIM

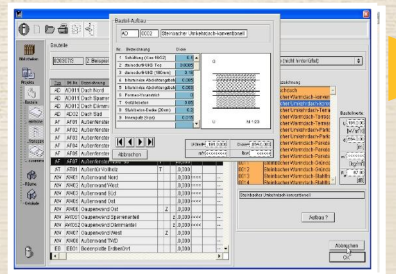

Input
Procedure
Output
Certified components based on masterformat WBS
Keynotes and families
Project orientation
Green building rating system
Suppliers information
Sustainable building materials and components collected in a based database
*.rvt
*.rfa
Keynotes
Project
BIM tool
3D design
Families
ODBC
txt
gbXML
LCA and embodied energy analysis
LEED and cost evaluation
Operational energy analysis and lighting simulation
Energy analysis report
Day light results
3D sustainable design
Sustainable materials
Environmental impacts
Embodied energy results

BIM as Collaborative Foundation

- Intelligent building model
- IFC (INDUSTRY FOUNDATION CLASS)- Seamless sharing and exchange of 3D model's information for generating building simulations
- Strategic partnership and cooperation with analysis software vendors









BIM

- Structural Engineering
- Collision Detection
- Code Checking
- Building Performance and energy simulations

Way to BIM

What is a model?

A model is a representation of something else.

A model is useful if it is able to:

- **Explain past observations.**
- **Predict future observations.**
- **Help control future events.**
- **Deliver value at a relatively low cost, especially in combination with other models.**
- **Be easily proven to be false or inaccurate.**
- **Present simplicity, or even aesthetic appeal.**

Who is the typical building simulation client?

ARCHITECTURAL

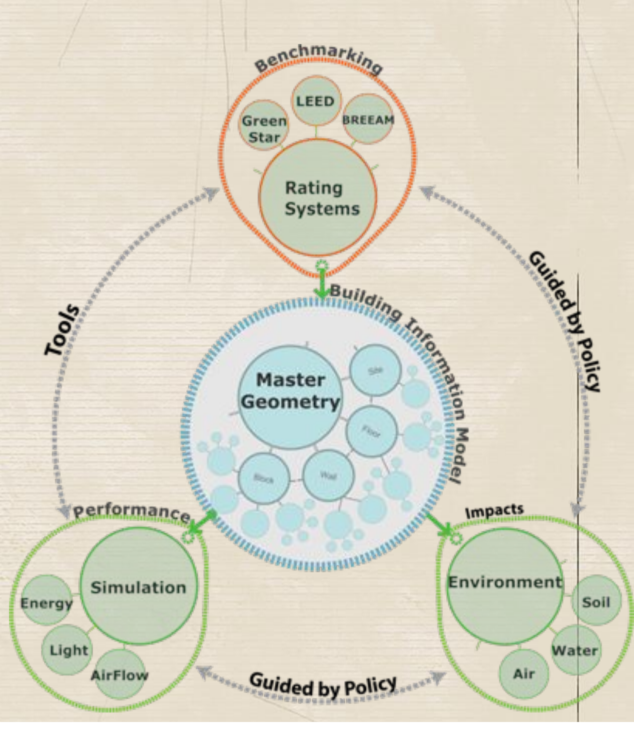
- Designers
- Architects
- Master planners
- Urban designers
- Interior Designers

ENGINEERS

- HVAC
- Mechanical
- Electrical
- Building Physics

rating systems

- Egyptian Green Building
- BREEAM
- LEED
- DGNB
- Estidama
- Gsas
- Other “green” rating systems













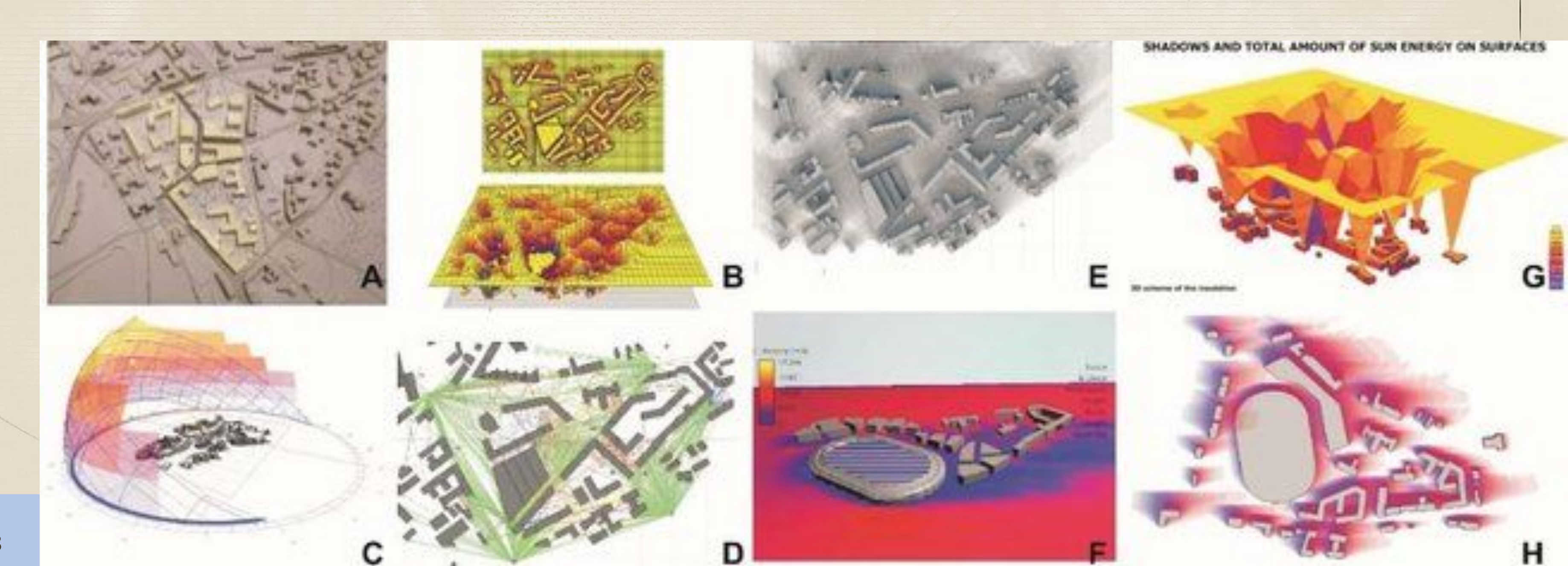
Rating systems, that are used to evaluate and benchmark sustainability, are constantly evolving

Adoption of "sustainable building rating systems offer a **roadmap** that lead to sustainability goals and help align requirements"



Results from BIM software analysis.

A. Physical model,
B. Model transposition to the software,
C. Sunlight analysis on surfaces determine the amount of passive energy,
D. Sound/noise analysis,
E. Analysis of the year shadow range,
F. Wind analysis,
G. Shadow analysis taking into account the annual passive energy distribution,
H. Colorful of the shadow range.



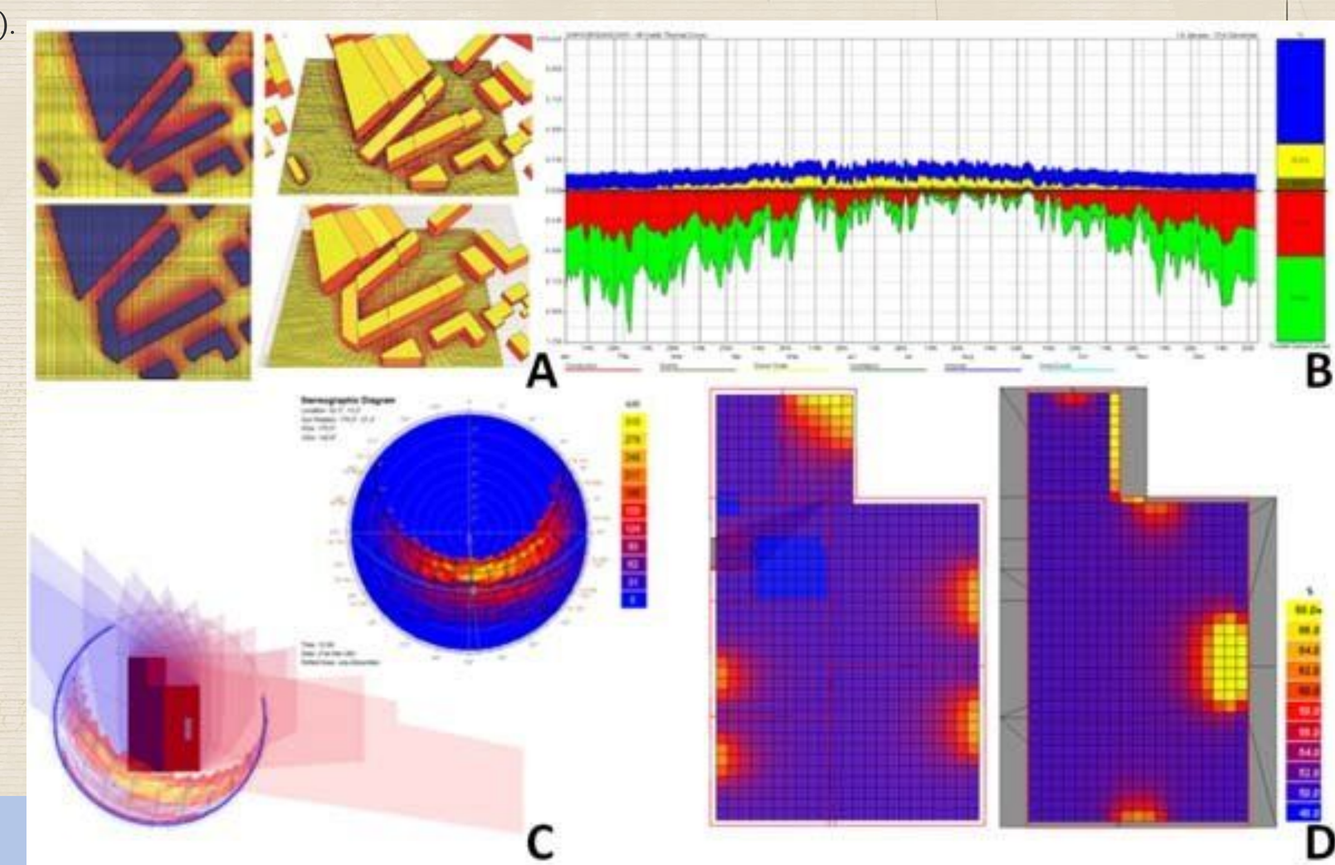
Results from BIM software analysis.

A. Shading analysis of surface sun exposure which attempts to re-design object structures;

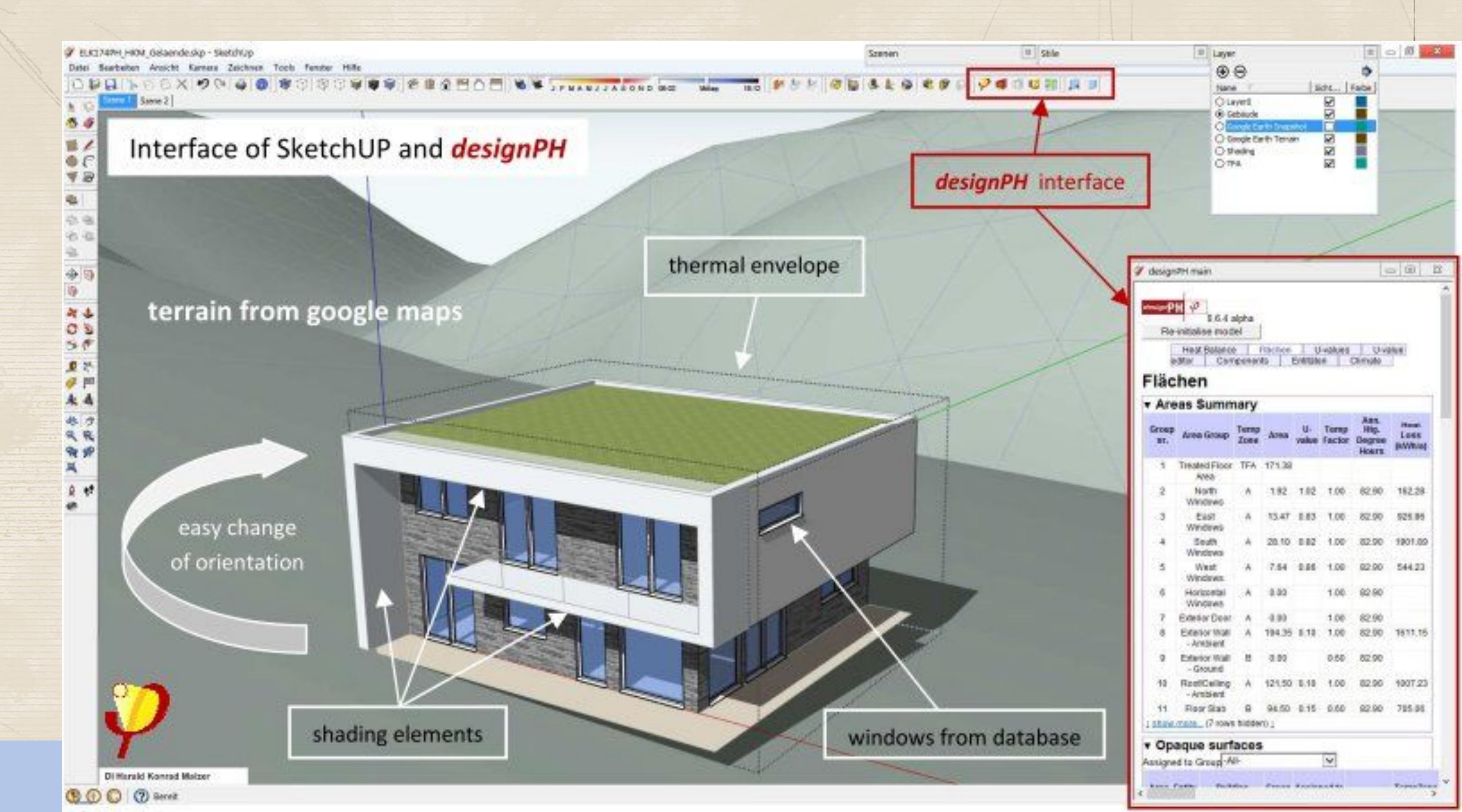
B. Thermal analysis-passive gains;

C. Shadow range and sun exposure;

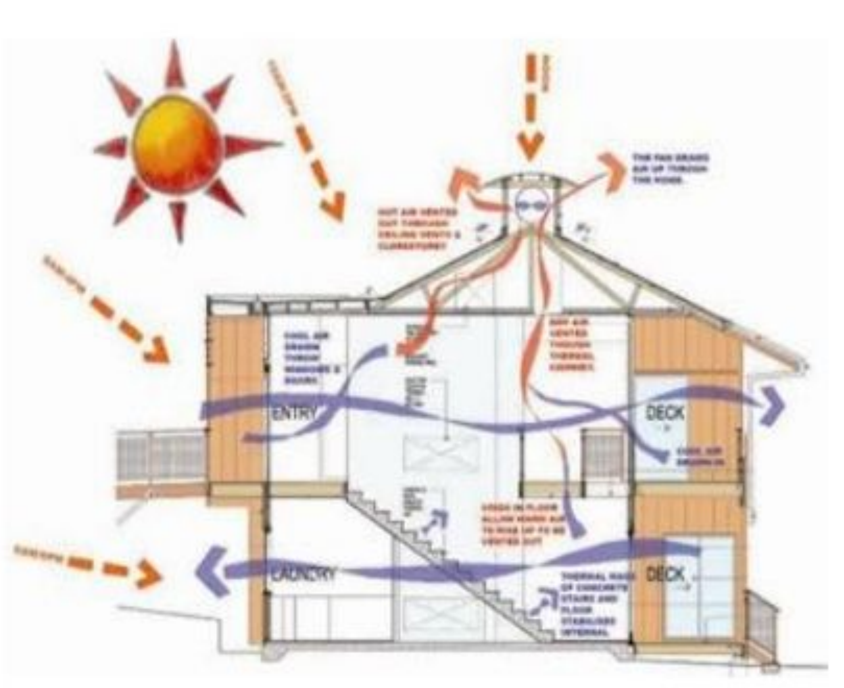
D. Internal solar access (Daylight saving).



Passive Design



Sustainable architecture is integrating two aims include Technology and human's aim





BPS is multi-objectives

Energy Performance	Indoor Environmental Quality	Sustainability (wider scope)
Building envelope and its system	Thermal comfort (e.g. temperature, air velocity)	Primary energy
Interaction with large-scale energy grids	Air quality (e.g. CO_2 concentration)	CO_{2eq} emissions released
Embodied energy in materials	Visual comfort	Life cycle assessment of building materials
Performance standard: passive house, nZEB	Acoustic levels	Water treatment

Carbon

- Carbon footprinting with BIM helps us test conceptual designs so we can specify solutions with the lowest carbon impact. This allows us to identify low carbon options that have the potential to drive down carbon emissions during the design and construction phases, as well as options that lead to carbon savings during a building's operation.



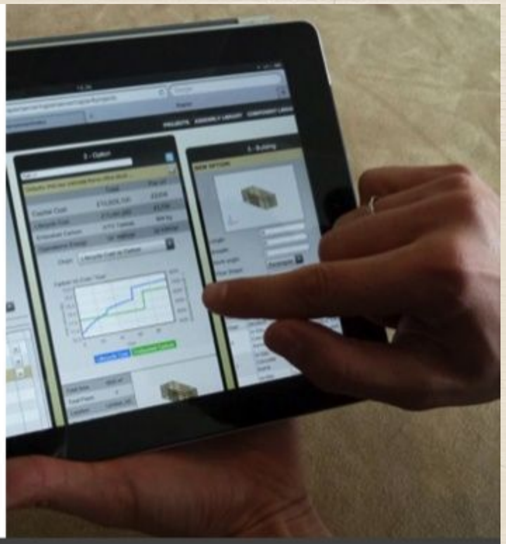
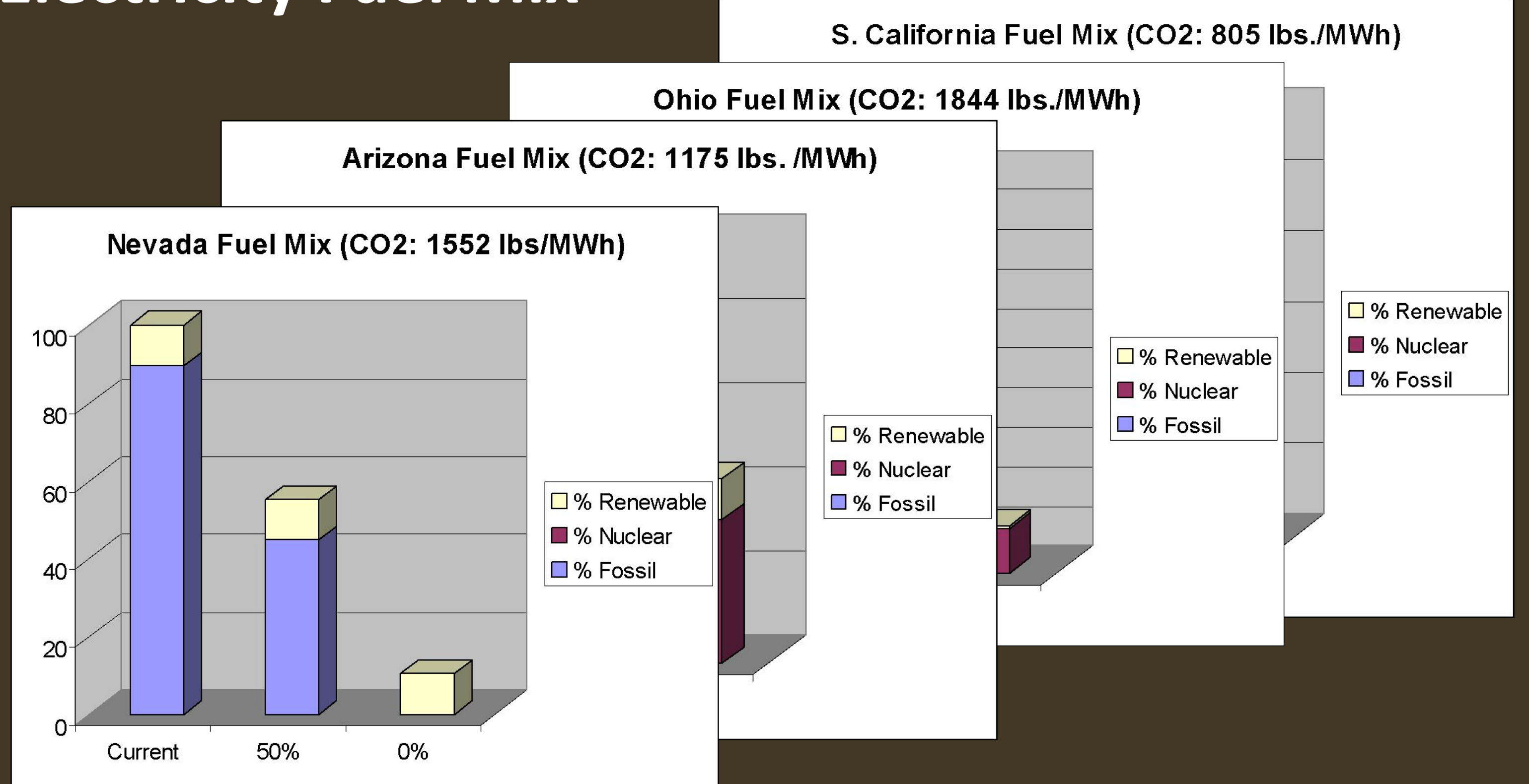


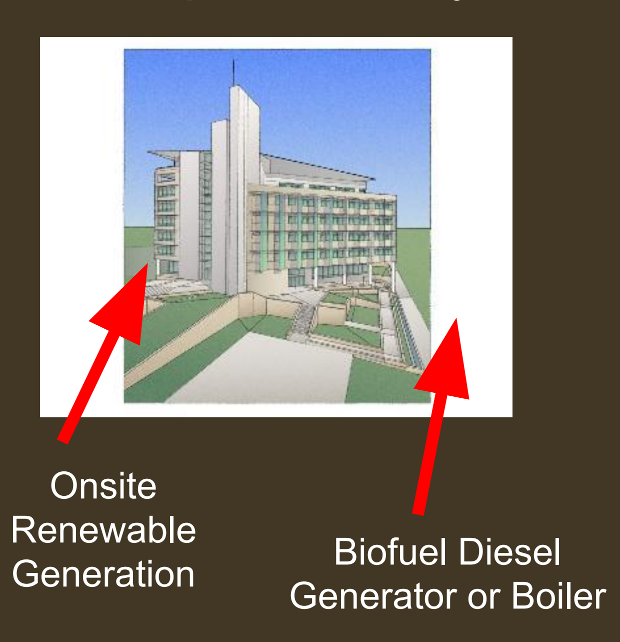
Image: rapiere.net   Declaration: Architype are one of the founding partners of Rapiere

Carbon Footprint Varies - Regional Electricity Fuel Mix



A Carbon Neutral Building – Simple Example

Requires a Very Efficient Building



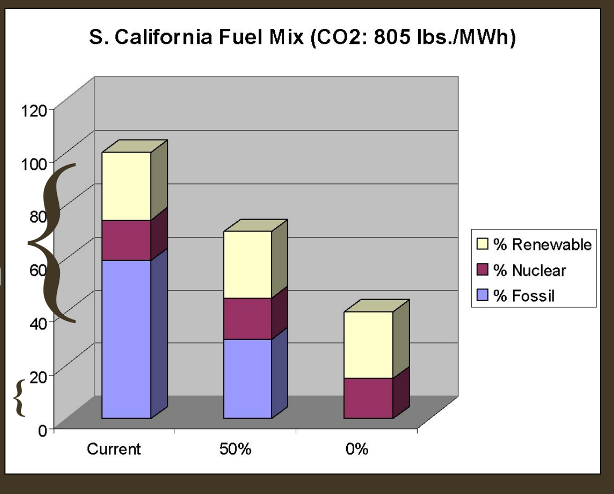
Onsite Renewable Generation

Biofuel Diesel Generator or Boiler

Grid Electricity

40% non-carbon

60% reduction in grid electricity




Financial Overview
NUMBER OF CONTRACTS
73
REVENUES THE NEXT 12 MONTHS
$12.717M
COSTS THE NEXT 12 MONTHS
$35.954M
NUMBER OF PROJECTS
17
NUMBER OF CHANGE ORDERS
139
COST VS. REVENUES BY YEAR
Costs
Revenues
CONTRACTS TO REVIEW
7
Contracts without milestones
9
Contracts without tasks
You have 7 contracts without future milestones and 9 contracts without assigned tasks.
PROJECTS BY STATUS
CHANGE ORDERS BY STATUS
PROJECTS BY STAGE


Project Management Overview
Ongoing Activities
4
Late Activities
3
OPEN SUBMITTALS BY TYPE
RFI's BY STATUS
PROJECT SCORECARD


CO2 Emissions Overview
$47.97B
Total Sales
Energy Sources
Renewable
Brown Coal
Nuclear
Gas
Production Costs (Cent Per kWh)
Brown Coal
Gas
Nuclear
Renewable
Sales By Sector
Industry
Private
Traffic
Craft, Trade, Service
Number Of Power Cuts & Avg Duration
Power Cuts
Duration


Quality & Safety Overview
Defects by type and severity
Injuries over time by harm source
Open inspections by trade
Open inspections by trade/punch items
Overall inspection progress

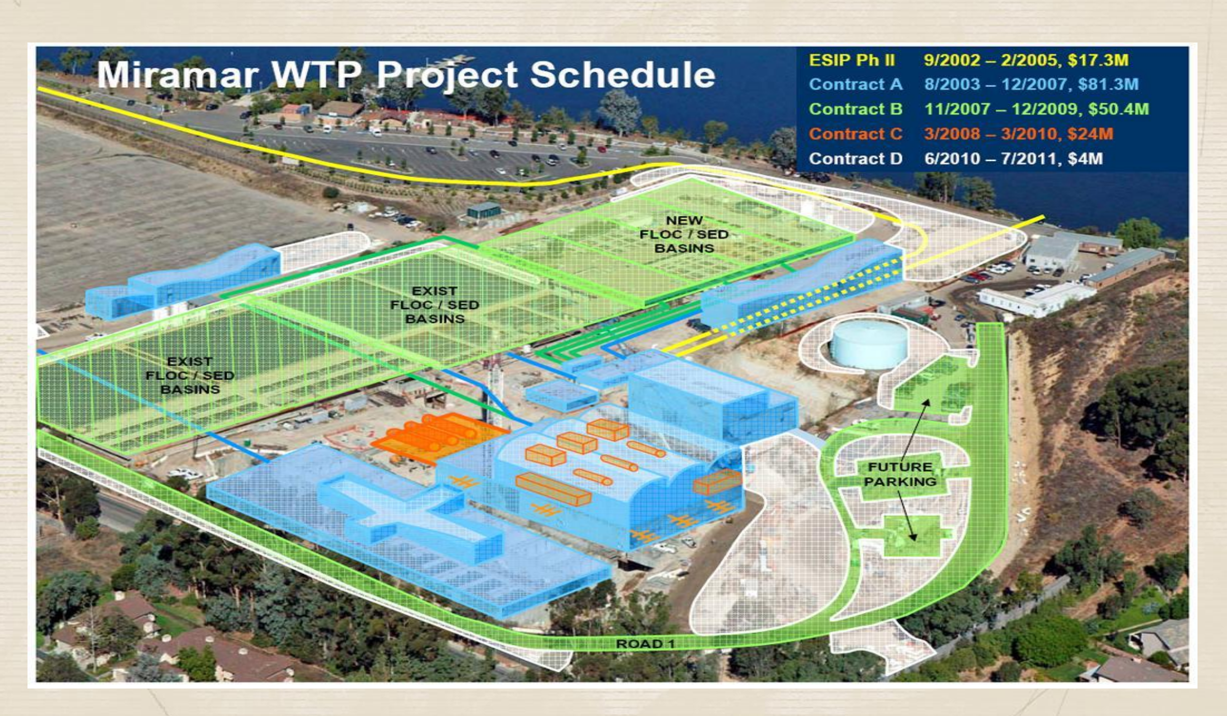
Way to BIM

Water

- BIM helps to quantify the amount of water used in a building by calculating the number of fixtures (sinks, toilets, etc.) and their related water usage. This also helps us measure the potential for greywater reuse, which is highly beneficial for reducing demand on local water supplies. The amount of water available for harvesting can be calculated using BIM, based on the site, harvesting system, and the size of building.

What are the main sustainability challenges that society faces today?

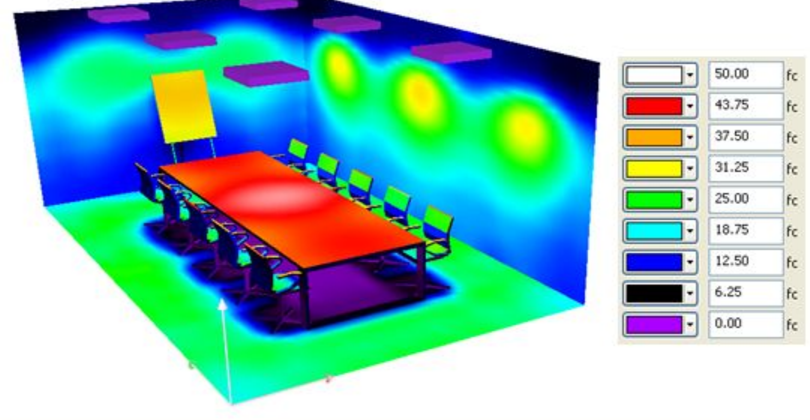
Maintaining and Expanding Access to Fresh Water



Aerial map of Miramar Water Treatment Plant Project with contract phase overlays, by L. Robin, 2009, courtesy The City of San Diego, California

Meeting Room Lighting

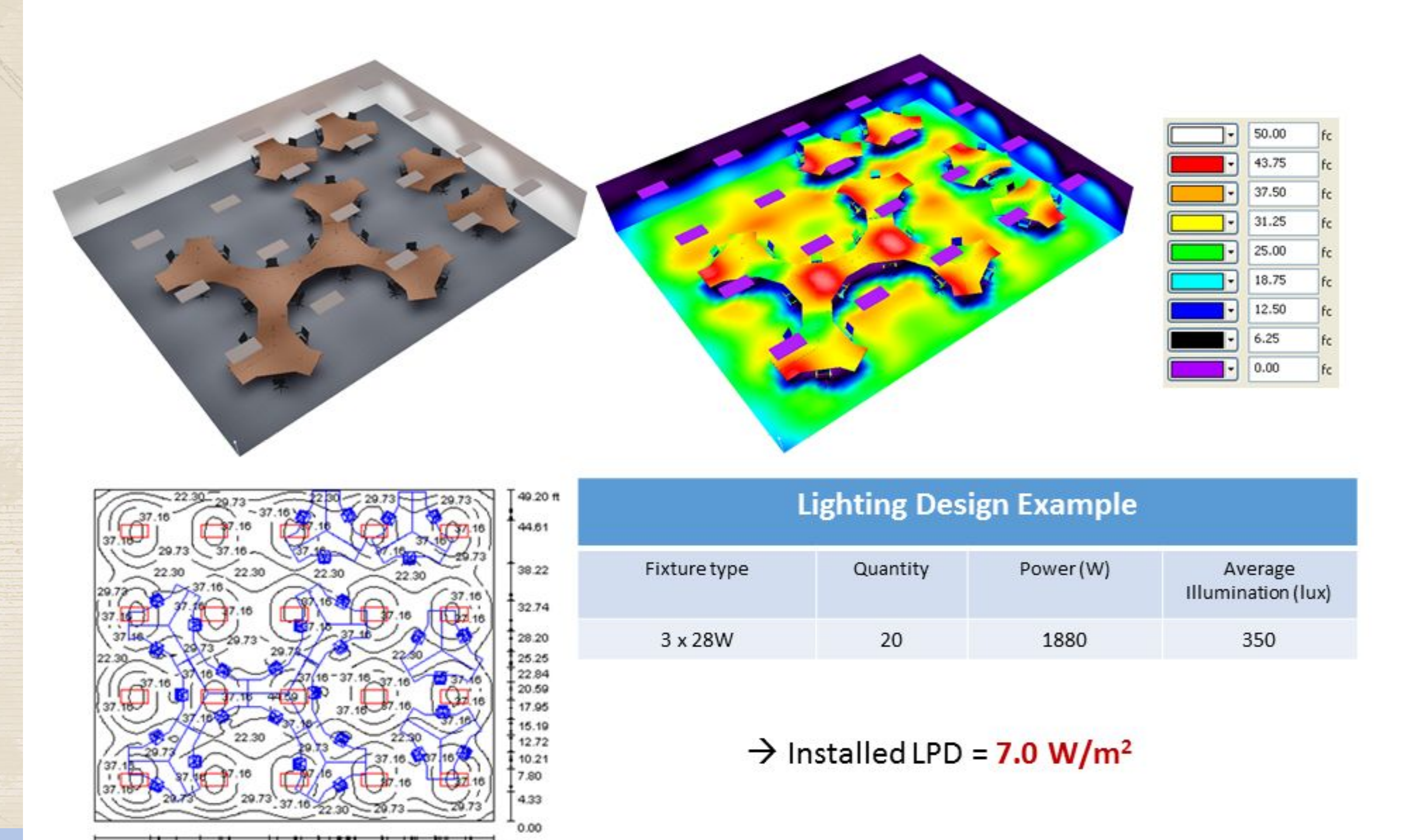




Lighting Design Example			
Fixture type	Quantity	Power (W)	Average Illumination (lux)
3x14 W	6	288	375

→ Installed LPD = **9.5 W/m²**

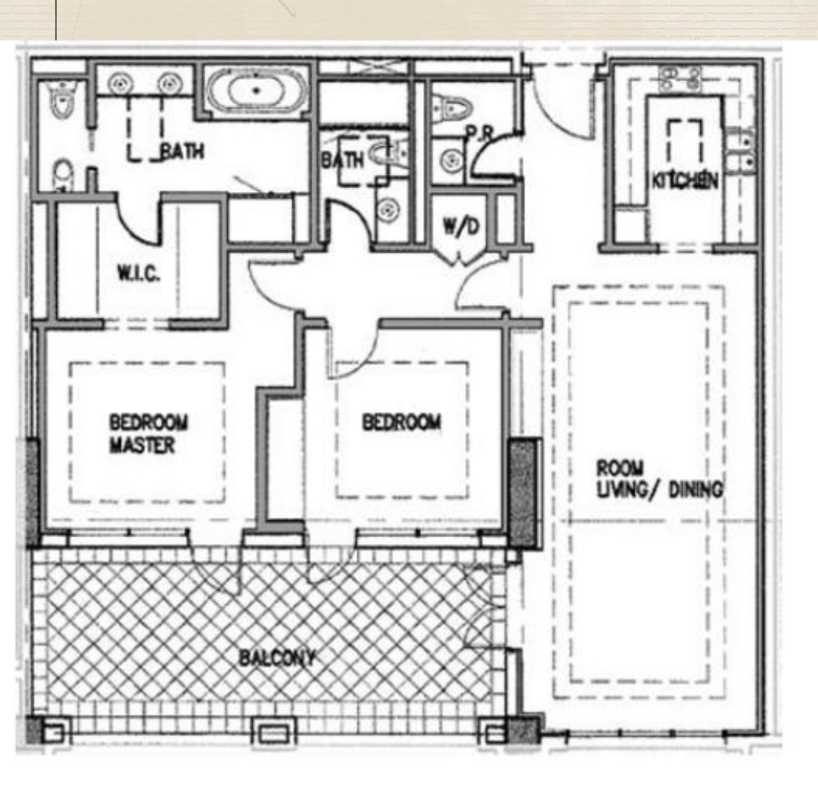
Open Office Space Lighting



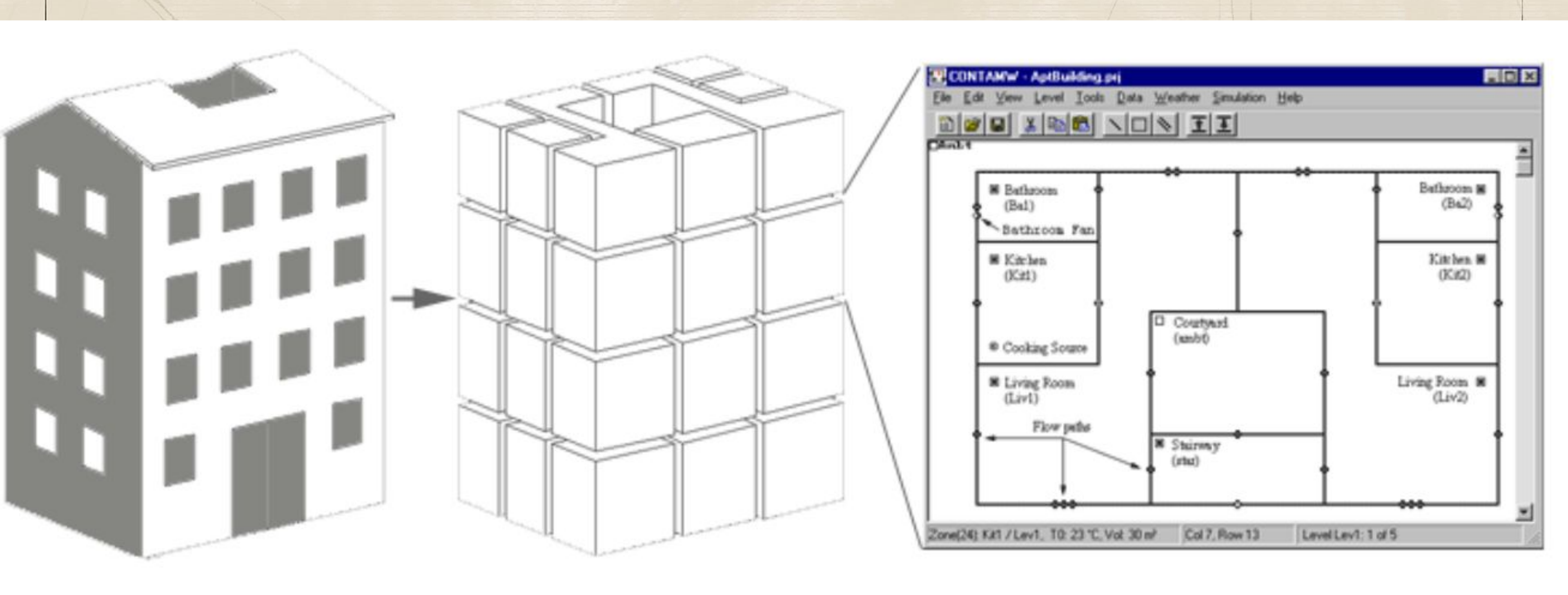
Lighting Design Example			
Fixture type	Quantity	Power (W)	Average Illumination (lux)
3 x 28W	20	1880	350

→ Installed LPD = **7.0 W/m²**

Thermal Zoning



25200
9000
4800
4800
4800
4800
North Perimeter Zone
6m
West Perimeter Zone
6m
Centre Zone
East Zone
6m
South Perimeter Zone
6m
13200
3000


CONTAMW - AptBuilding.prj
File Edit View Level Tools Data Weather Simulation Help
Bathroom
(Ba1)
Bathroom Fan
Kitchen
(Kit1)
Cooking Source
Living Room
(Liv1)
Flow paths
Courtyard
(ambt)
Stairway
(stai)
Bathroom
(Ba2)
Kitchen
(Kit2)
Living Room
(Liv2)
Col 7, Row 13
Level Lev1: 1 of 5

Way to BIM

Criteria For Zoning An Energy Model Usage

• All rooms should have similar internal loads and usage schedules Temperature Control

• All rooms should have the same Tstat schedules Solar Gains

• Perimeter zones with windows: Min. one zone for each compass direction

• Unglazed exterior zones can be combined

• Consider shading!

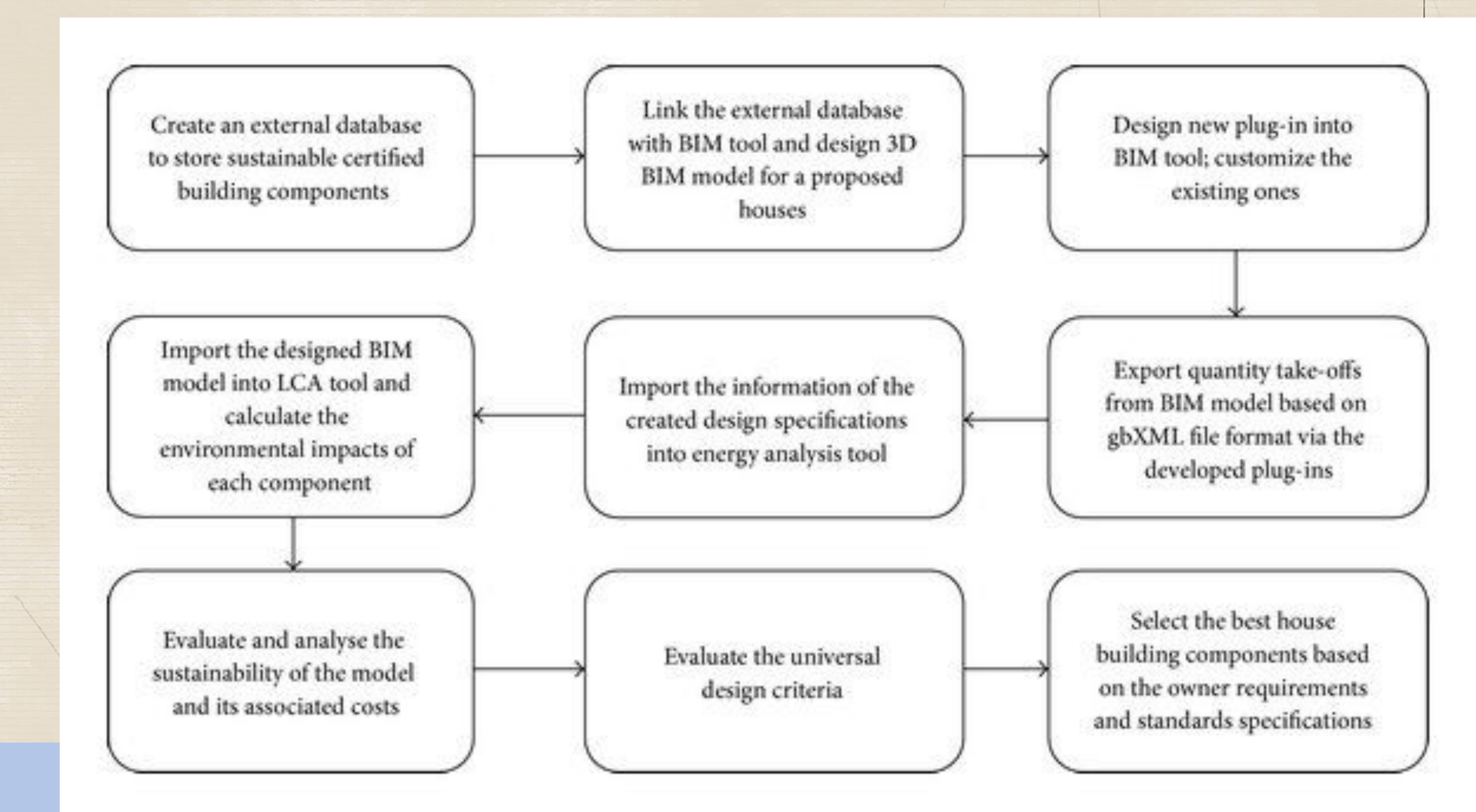
Perimeter or Interior Location

• 12-15' perimeter zones often require winter heating

• Core spaces can require year round cooling Distribution System Type

•Combine rooms served by the same type of distribution system (i.e.
fan coil units)

Methodology of the integration system



R&D - INDICATE



BUILDINGS

Large Scale Renewables

Electricity Grid

PLANNING

OPTIMISATION

REDUCTION

INTEGRATION

Small Scale Renewables

EV Grid

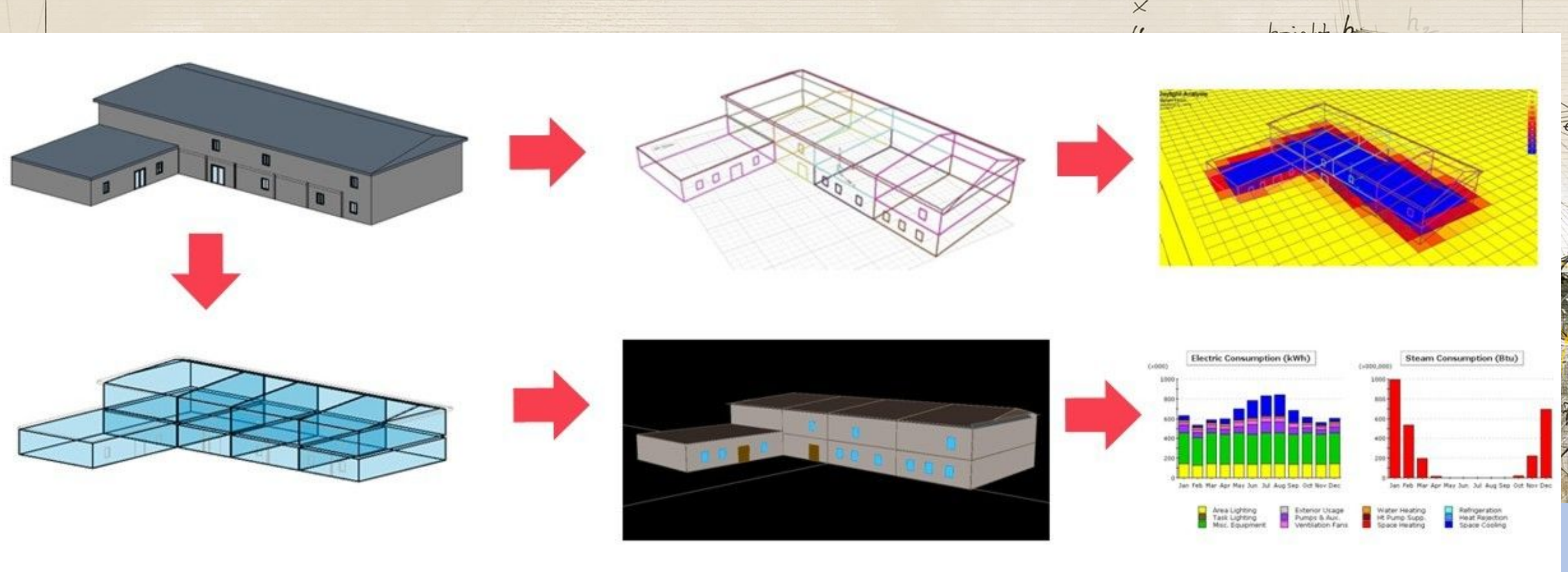
SUSTAINABLE INDICATORS FOR THE URBAN CONTEXT

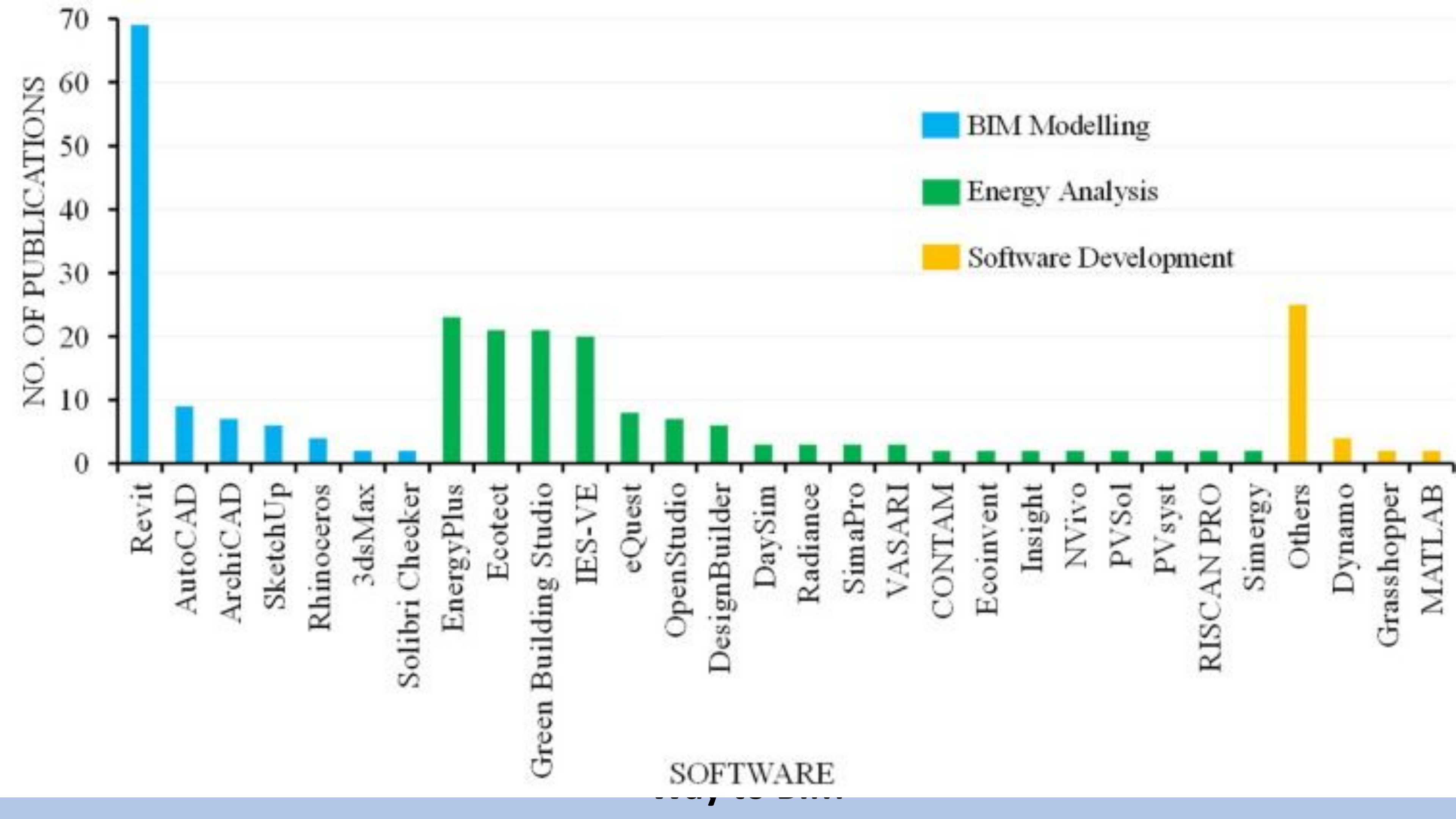
Energy Use
Waste Network
Transport Network
Climate Change
Urban Heat Island Effect
etc

www.iesve.com UNITED KINGDOM | IRELAND | UNITED STATES OF AMERICA | CANADA | INDIA | AUSTRALIA

SOFTWARE

"Software doesn't design sustainable buildings, people do." – Elrond Burrell





NO. OF PUBLICATIONS
70
60
50
40
30
20
10
0
BIM Modelling
Energy Analysis
Software Development
Revit
AutoCAD
ArchiCAD
SketchUp
Rhinoceros
3dsMax
Solibri Checker
EnergyPlus
Ecotect
Green Building Studio
IES-VE
eQuest
OpenStudio
DesignBuilder
DaySim
Radiance
SimaPro
VASARI
CONTAM
Ecoinvent
Insight
NVivo
PVSol
PVsyst
RISCAN PRO
Simergy
Others
Dynamo
Grasshopper
MATLAB
SOFTWARE

SOFTWARE

List of approved LEED software

- DOE2
- eQUEST
- Visual DOE
- EnergyPlus
- EnergyPro
- HAP (Carrier HAP)
- TRACE 700 (Trane TRACE)
- BLAST (not mentioned within the LEED form, but listed in 90.1 section G2)
- IES (Integrated environmental solutions, listed in LEED Advanced energy modeling .

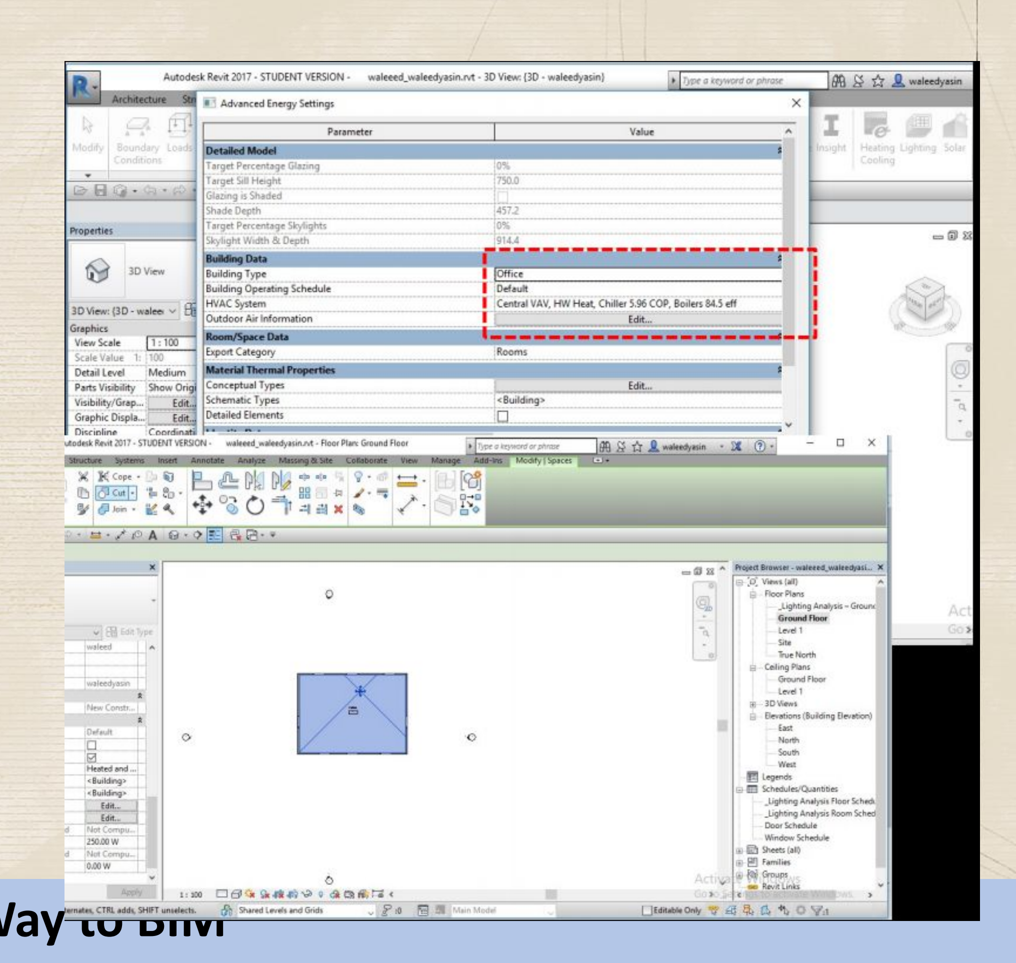
Energy simulation programs

approved by Canada Green Building

- Council (CaGBC):
- eQuest
- EE4
- DOE-2
- EnergyPlus
- IES Virtual Environment,
- Hourly Analysis Program (HAP)
- TRACE 700
- EnergyPro v5.1.

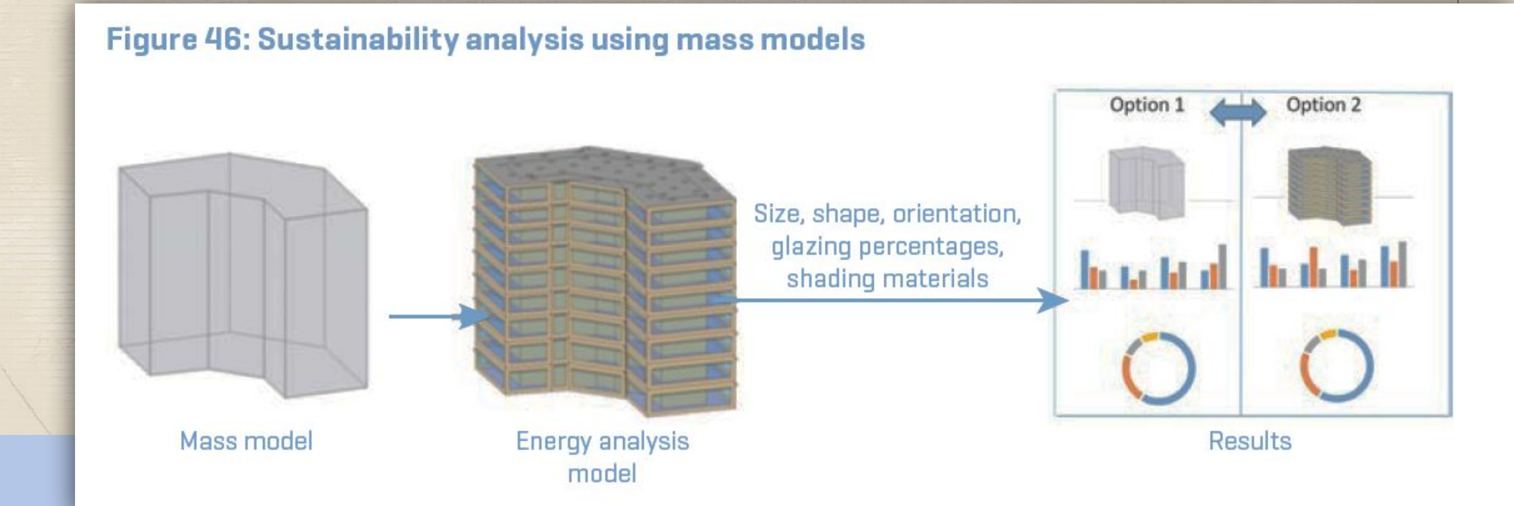
ENERGY CONSUMPTION – HVAC LOAD – THERMAL COMFORT

- FUNCTION
- OCCUPANCY
- CONSTRUCTION
- LIGHTING
- SCHEDULE
- HVAC SETPIONT
- DEMOSTIC WATER
- MECHANICAL VENTILATION
- NATURAL VENTILATION
- INFILTRATION •(ACH)

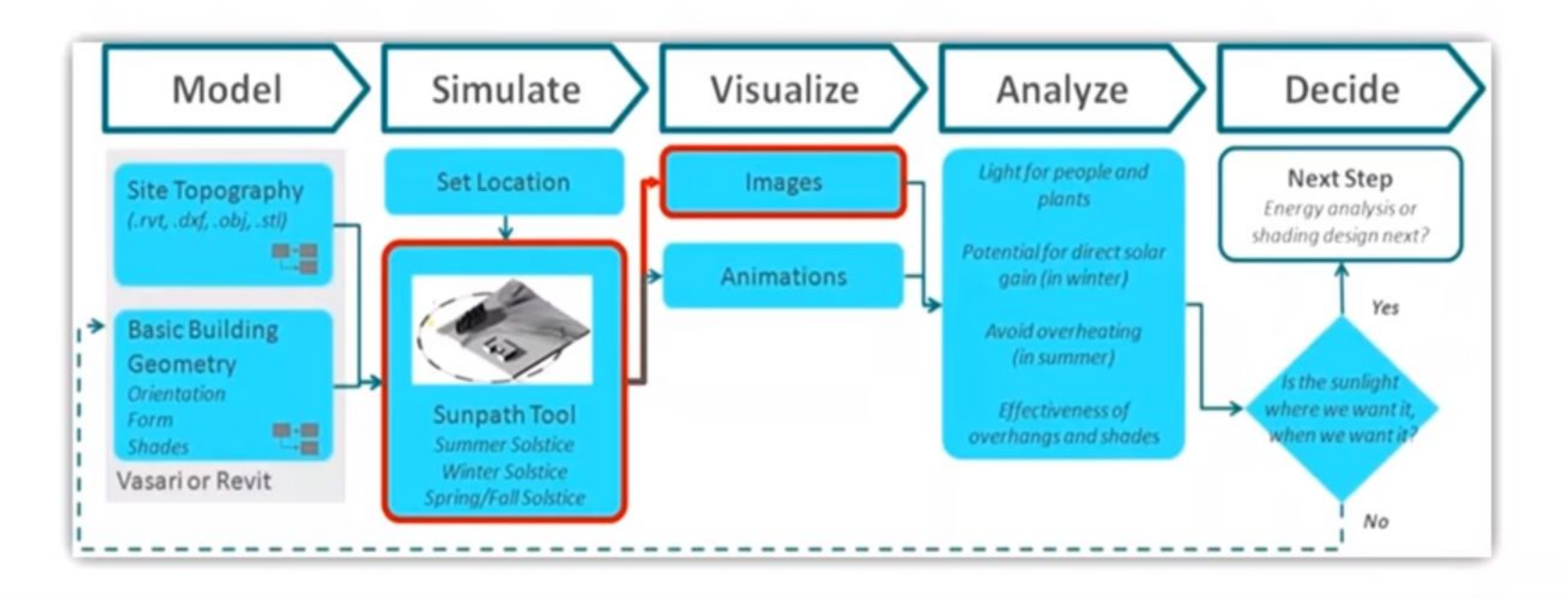


Energy Modeling

- Using BIM in the design process helps us evaluate energy efficiency and make recommendations for design alternatives that will enhance a building's performance. By combining BIM with specialized energy modeling software, every part of a building, from MEP (Mechanical, Electrical & Plumbing) systems to interior climate, can be simulated and optimized for energy efficiency.



Solar Studies Overview

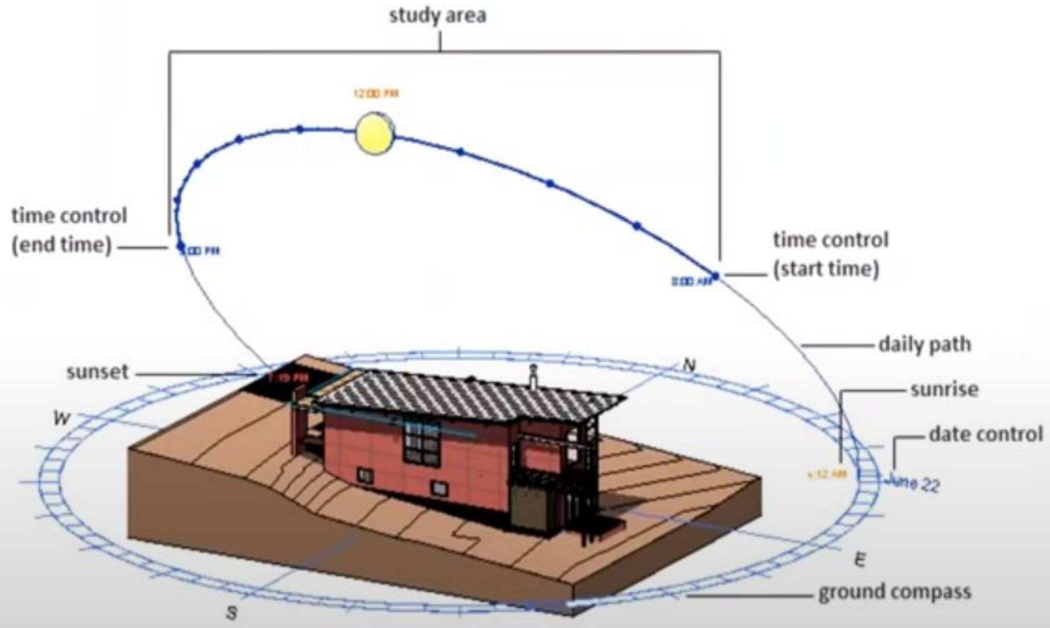


By showing the impact of natural light and shadows on your project, solar studies yield valuable information that can help support effective passive solar design. Use solar studies to visualize how shadows from terrain and surrounding buildings affect the site, and where natural light penetrates a building during specific times of the day and year

Solar Studies Overview

Sun path :-

The sun path is a visual representation of the sun's range of movement across the sky at the geographic location you specify for a project. The sun path displays in the context of your project and includes on-screen controls for positioning the sun at any point within its range of movement, between sunrise and sunset, throughout the year.



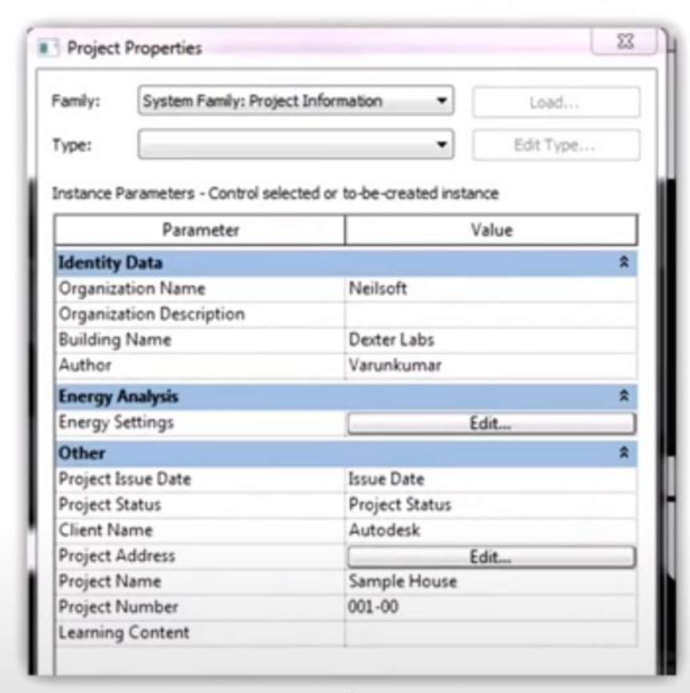
Solar Studies Workflow

Use the following workflow to create solar studies, using both the sun path and Sun Settings dialog.

Create a project → Project Information → Specifying the Project Location → Create Views for Solar Studies → Turn on the sun path and shadows → Perform various Types of Solar Studies (Still / Single Day / Multi-Day) → Previewing Solar Study Animations → Saving Solar Study Images to Projects → Exporting a Solar Study Report.

Solar Studies Workflow

Use the following workflow to create solar studies, using both the sun path and Sun Settings dialog.



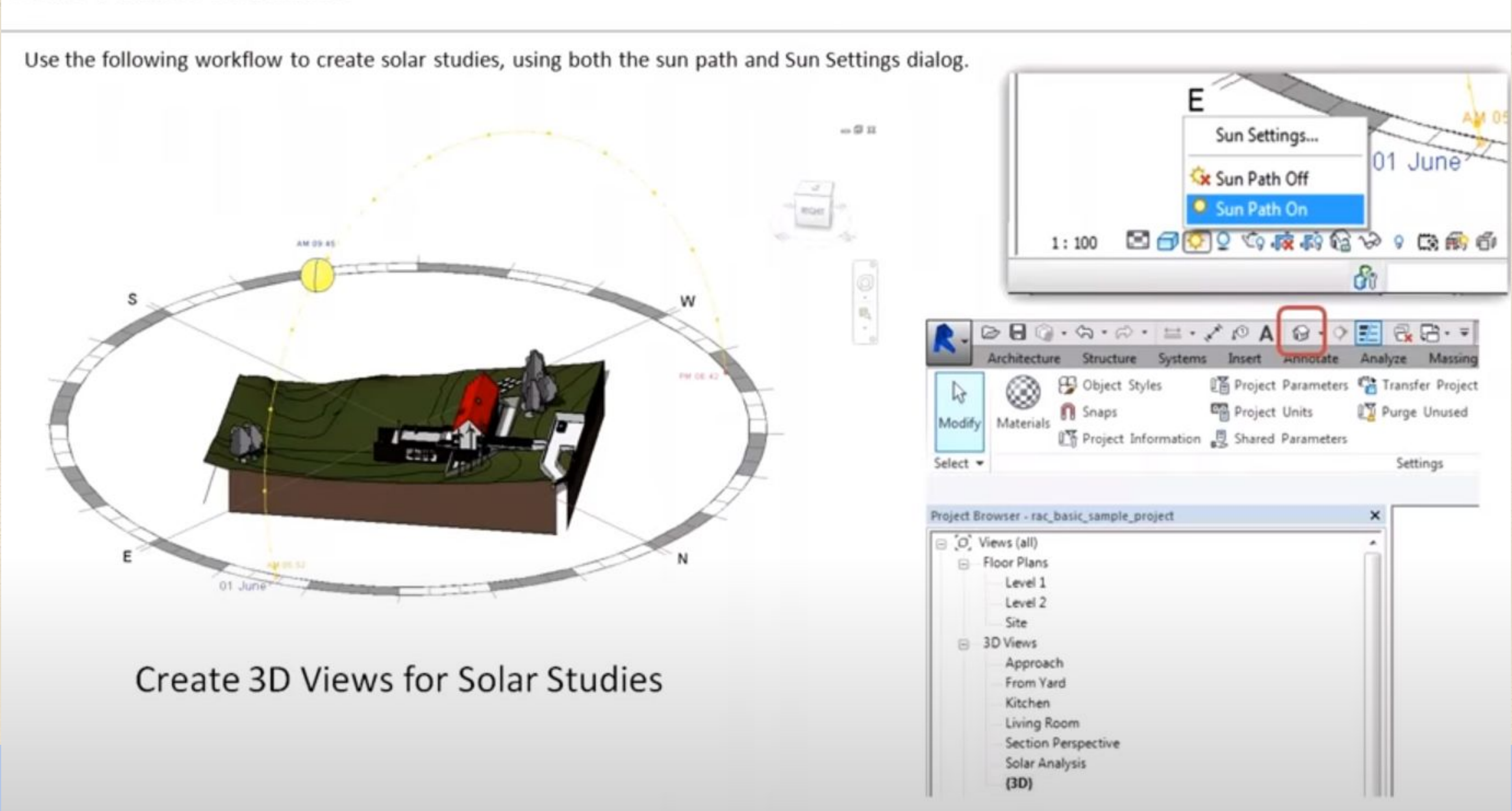
Project Information



Specifying the Project Location

Solar Studies Workflow

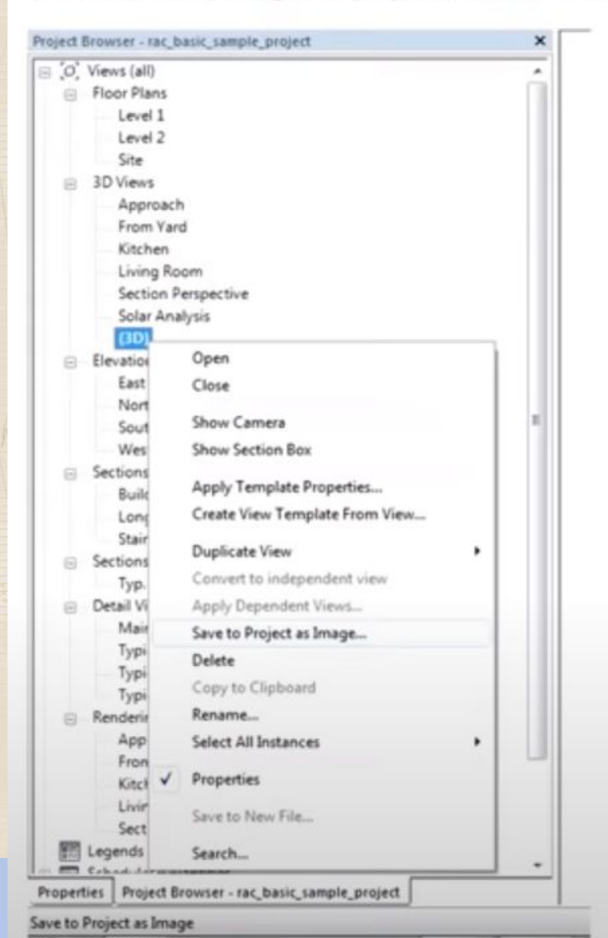
Use the following workflow to create solar studies, using both the sun path and Sun Settings dialog.



Create 3D Views for Solar Studies

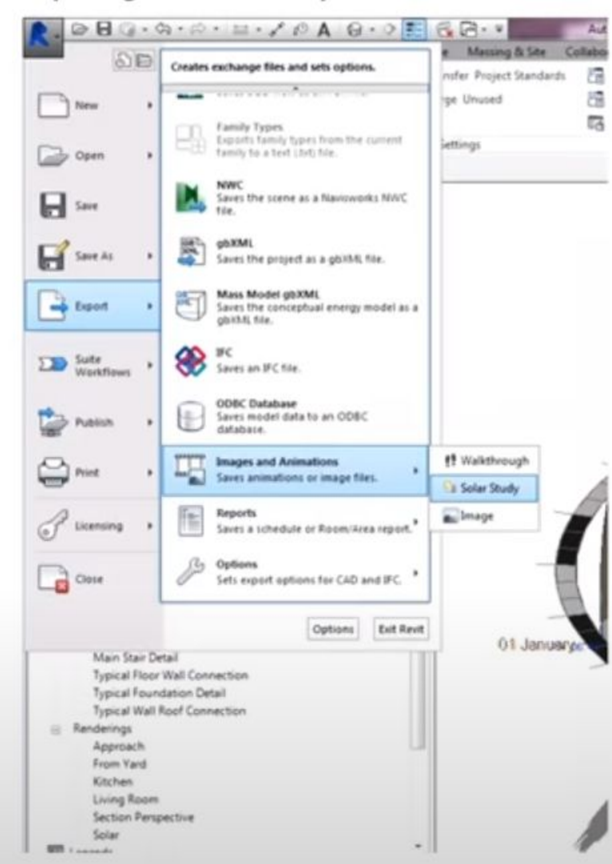
Solar Studies Workflow

Save solar study images to projects for later reference.



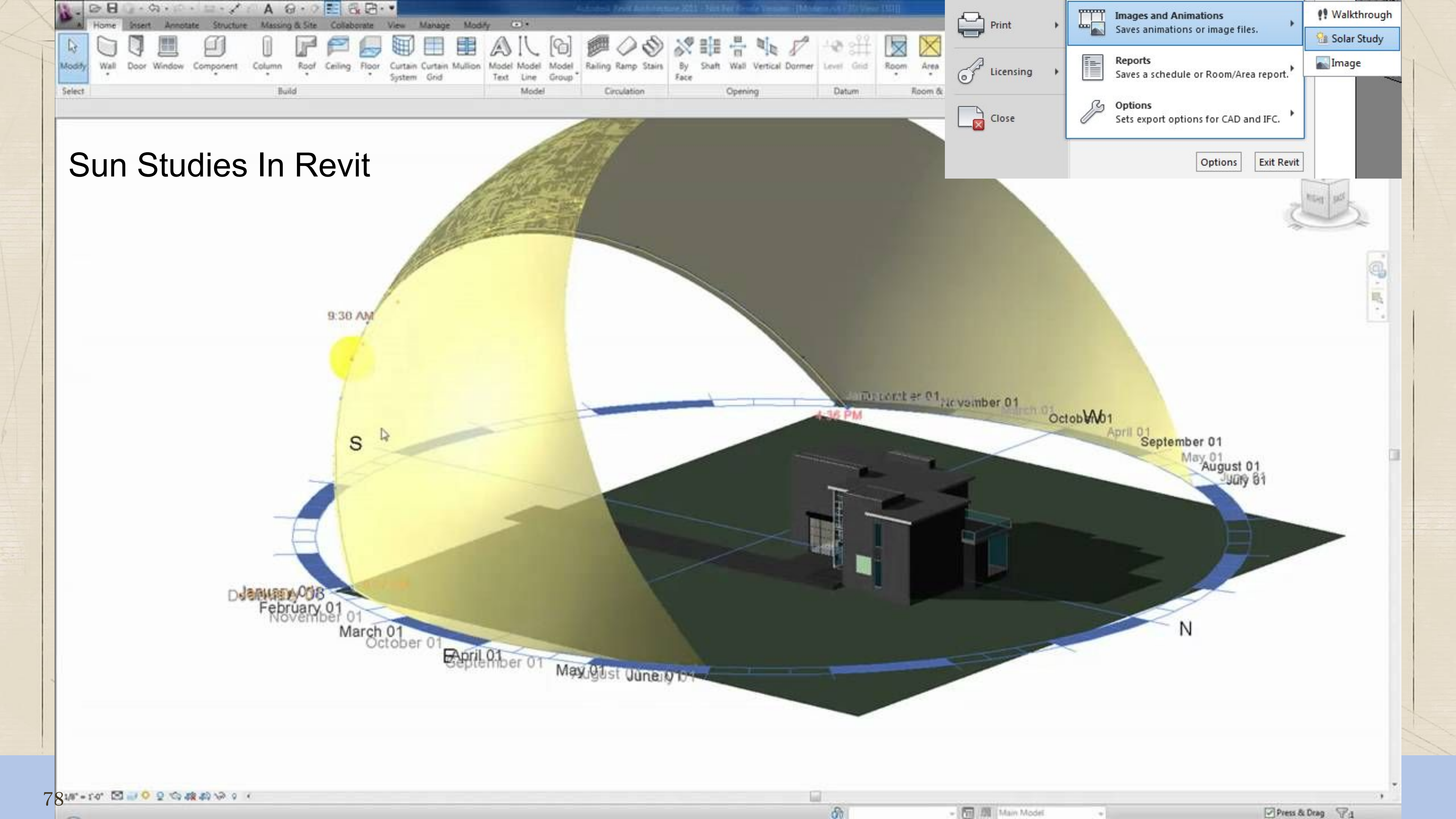
Solar Studies Workflow

Exporting the Solar Study Animations

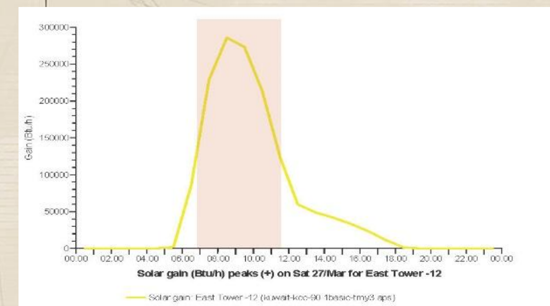


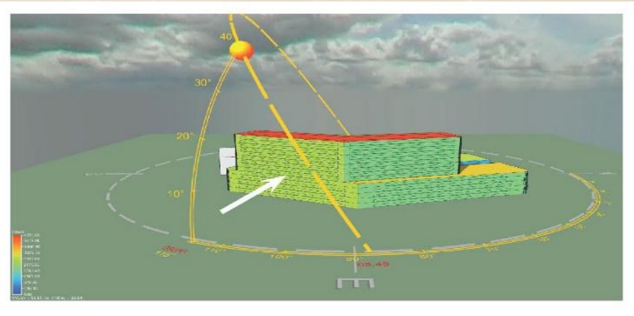





Sun Studies In Revit
Home
Insert
Annotate
Structure
Massing & Site
Collaborate
View
Manage
Modify
Print
Licensing
Close
Images and Animations
Saves animations or image files.
Reports
Saves a schedule or Room/Area report.
Options
Sets export options for CAD and IFC.
Walkthrough
Solar Study
Image
Options
Exit Revit
9:30 AM
S
W
N
September 01
August 01
February 01
March 01
October 01
April 01
May 01

Why BIM ,,Benefits of BIM,,



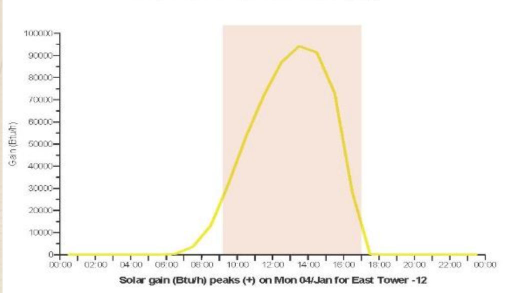


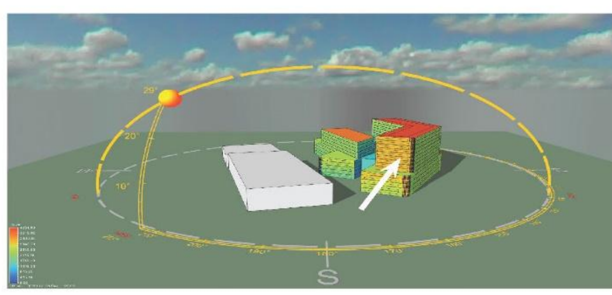
Analysis of total annual hours of sun exposure per major facade orientation. Provide shading to control the peak time of solar gain. Shading will reduce energy use and improve occupant comfort.

Red = Most , Blue = Least

EAST ELEVATION
Sun location: Horizontal 115 d / Vertical 40 d

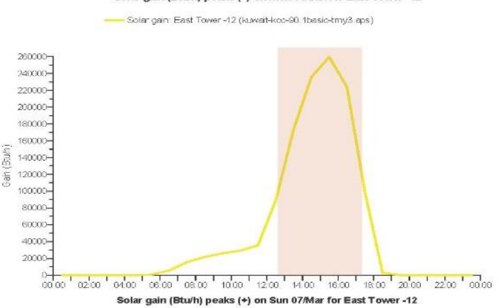
Shading approach: Both horizontal and vertical shading due to high sun angle.

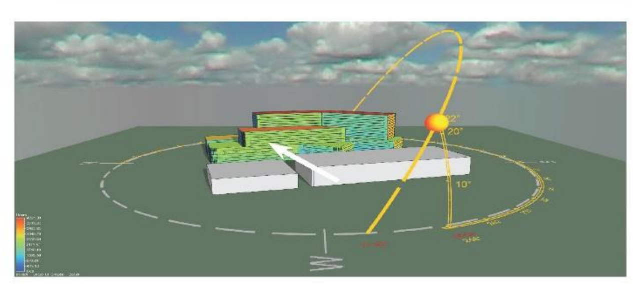




SOUTH ELEVATION
Sun location: Horizontal 213 d / Vertical 29 d

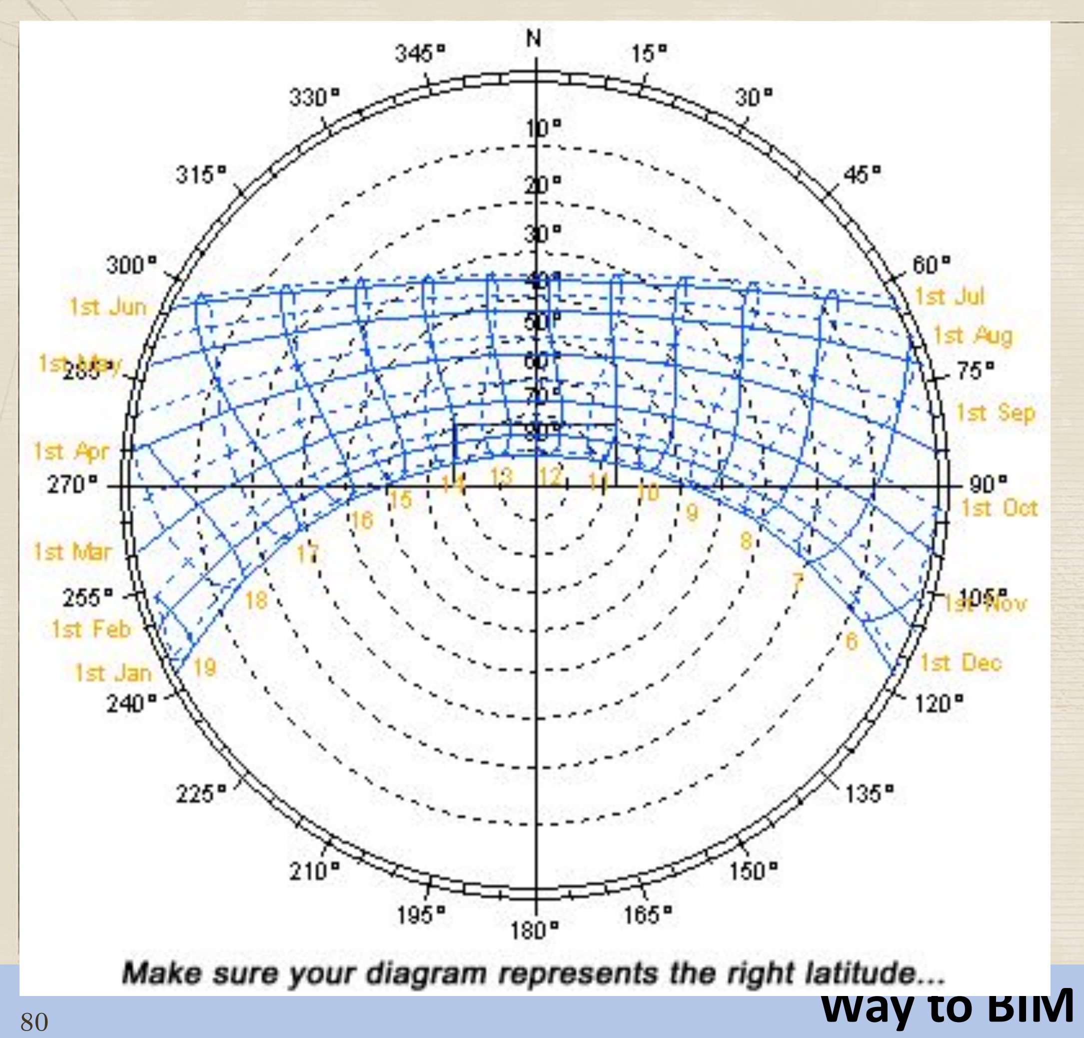
Shading approach: Horizontal shading with deep set windows.



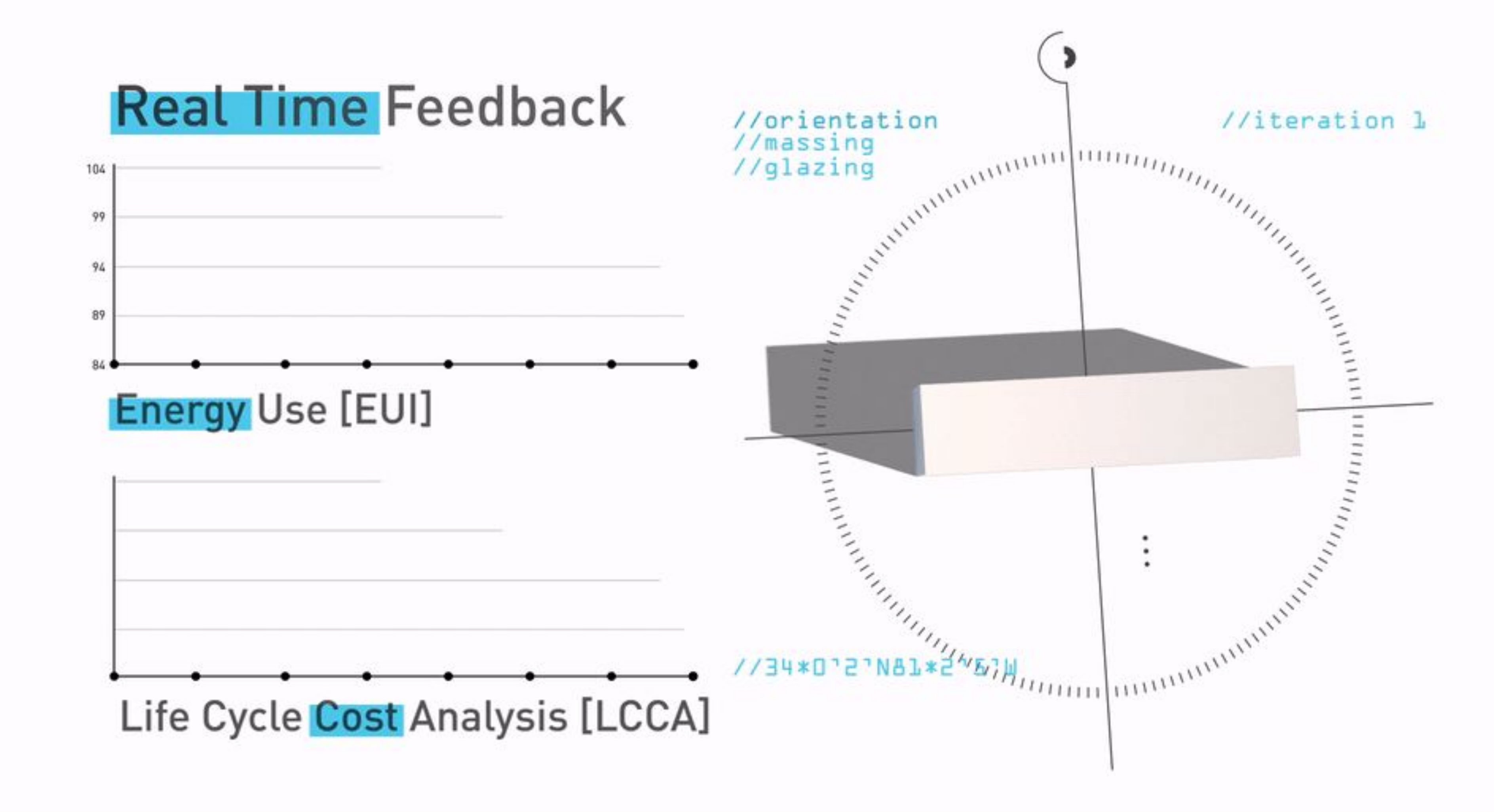


WEST ELEVATION
Sun location: Horizontal 248 d / Vertical 22 d

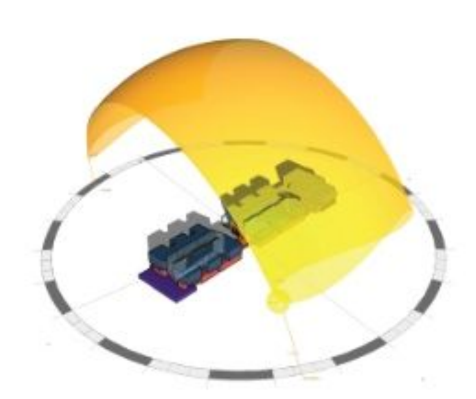
Shading approach: Screen to control low sun angle.


N
345°
15°
330°
30°
315°
45°
300°
60°
285°
75°
270°
90°
255°
105°
240°
120°
225°
135°
210°
150°
195°
165°
180°
10°
20°
30°
40°
50°
60°
70°
80°
1st Jun
1st May
1st Apr
1st Mar
1st Feb
1st Jan
1st Jul
1st Aug
1st Sep
1st Oct
1st Nov
1st Dec
19
18
17
16
15
14
13
12
11
10
9
8
7
6
Make sure your diagram represents the right latitude...

Way to BIM


Real Time Feedback
104
99
94
89
84
Energy Use [EUI]
Life Cycle Cost Analysis [LCCA]
//orientation
//massing
//glazing
//iteration 1
//34*0'2'N81*2'5'W

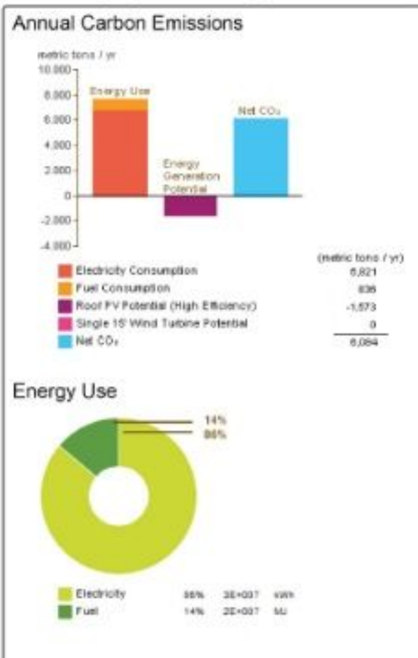
Mall Skylighting Preliminary Analysis

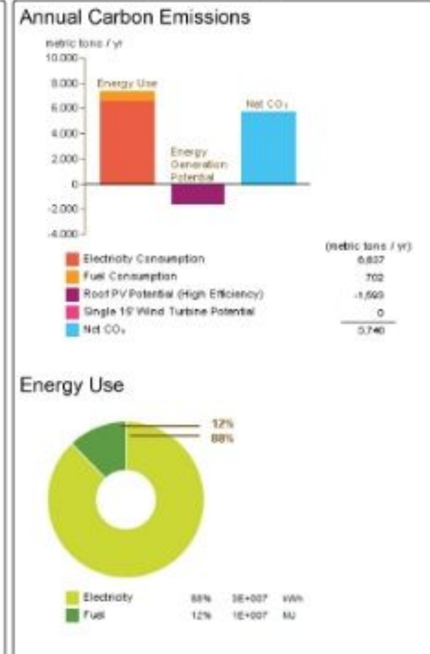


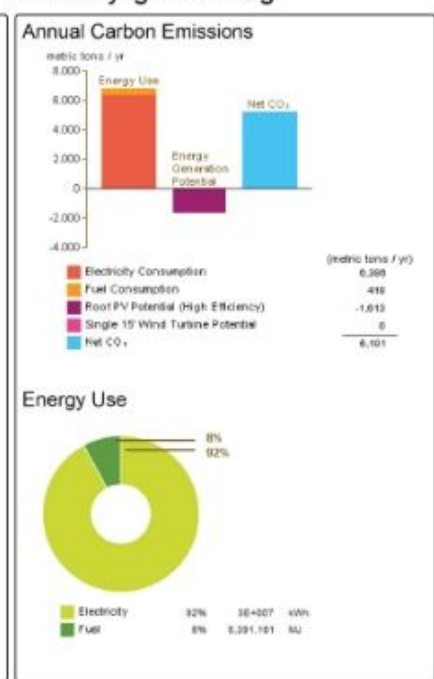
Annual Sun Exposure (8am - 5pm)

* Calculations assume 50% glazing on exterior faces throughout the rest of project, not including the theater

* The increase of efficiency is a percentage of the energy consumption over the entire project, not just the mall atrium spaces







Efficiency Increase (Metric Tons /yr)

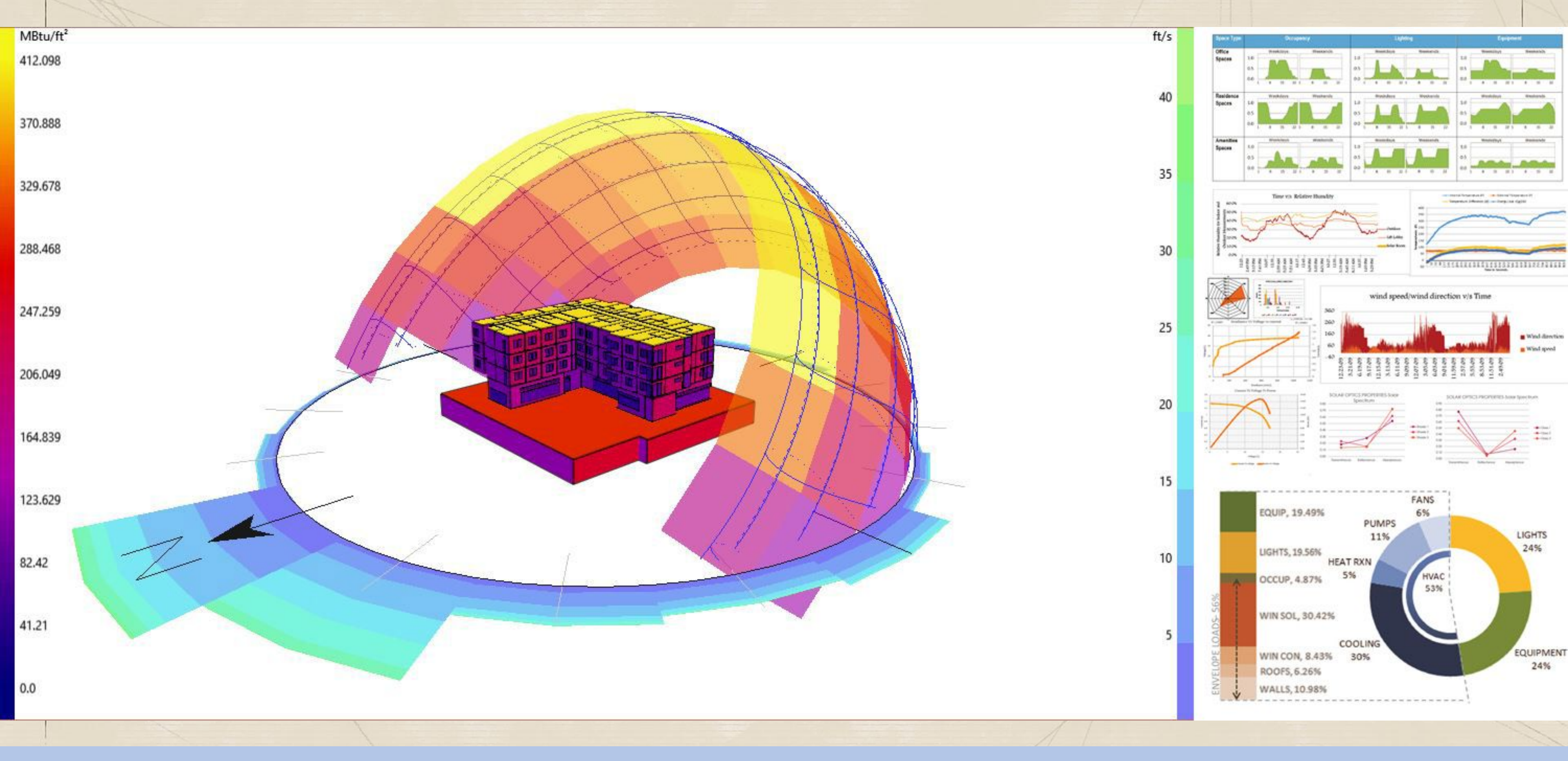
Elec. Consumption	-184 (2.7%)
Fuel Consumption	-134 (16.0%)

(Compared to 95% Skylight Glazing)

Efficiency Increase (Metric Tons /yr)

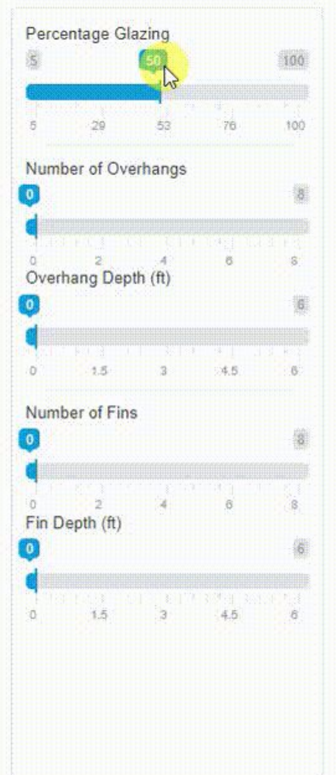
Elec. Consumption	-425 (6.2%)
Fuel Consumption	-418 (50.0%)

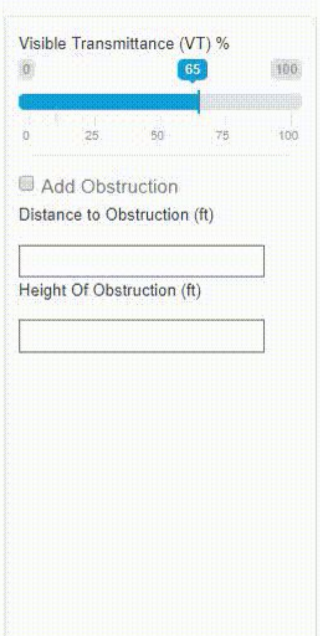
(Compared to 95% Skylight Glazing)


MBtu/ft²
412.098
370.888
329.678
288.468
247.259
206.049
164.839
123.629
82.42
41.21
0.0
ft/s
40
35
30
25
20
15
10
5
wind speed/wind direction v/s Time
EQUIP, 19.49%
LIGHTS, 19.56%
OCCUP, 4.87%
WIN SOL, 30.42%
WIN CON, 8.43%
ROOFS, 6.26%
WALLS, 10.98%
ENVELOPE LOADS- 56%
FANS 6%
PUMPS 11%
HEAT RXN 5%
HVAC 53%
COOLING 30%
LIGHTS 24%
EQUIPMENT 24%

Way to BIM

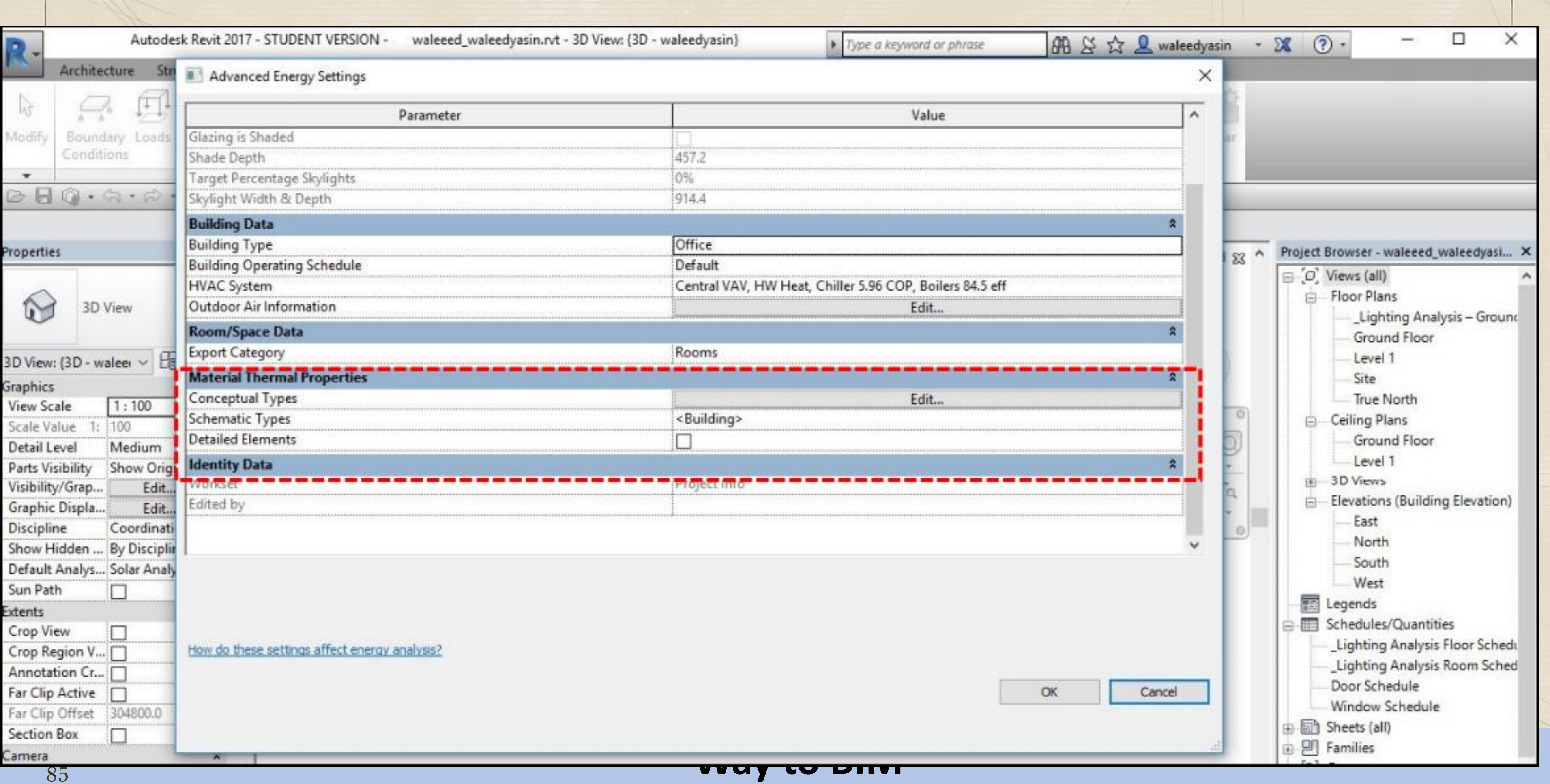

66.15% sDA


Percentage Glazing
5
50
100
5 29 53 76 100
Number of Overhangs
0
8
0 2 4 6 8
Overhang Depth (ft)
0
6
0 1.5 3 4.5 6
Number of Fins
0
8
0 2 4 6 8
Fin Depth (ft)
0
6
0 1.5 3 4.5 6

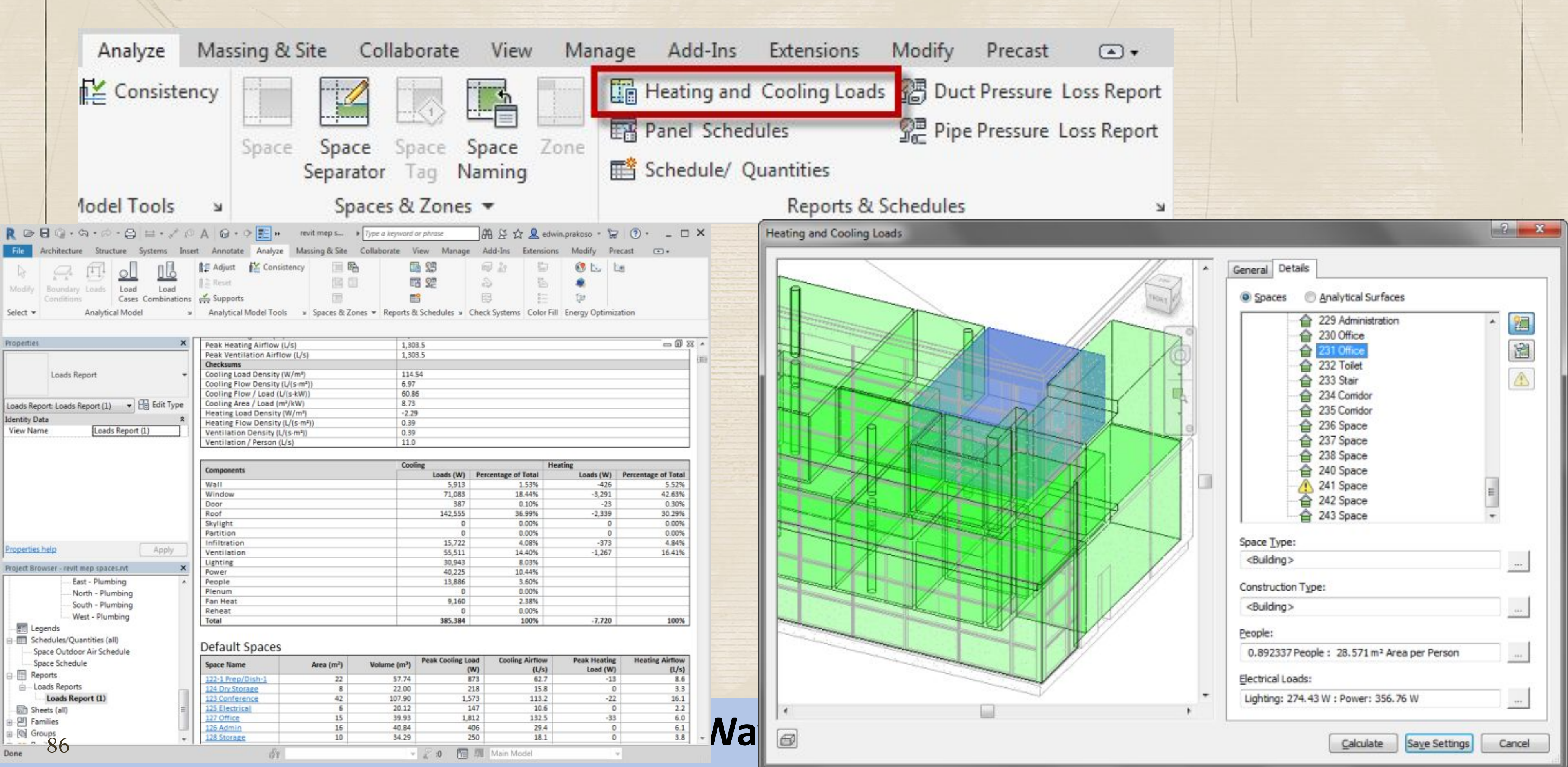

Visible Transmittance (VT) %
0
65
100
0 25 50 75 100
Add Obstruction
Distance to Obstruction (ft)
Height Of Obstruction (ft)

Way to BIM

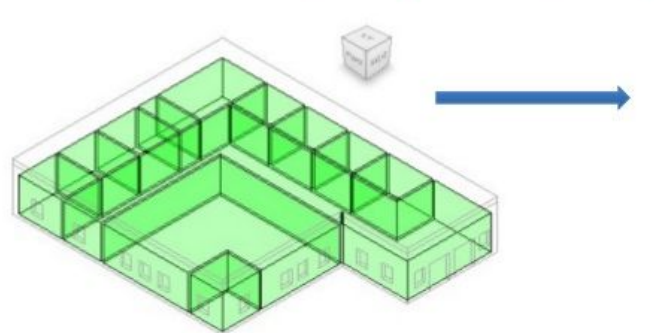
REVIT PRACTICE



Heating and Cooling Load Calculation

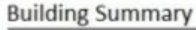


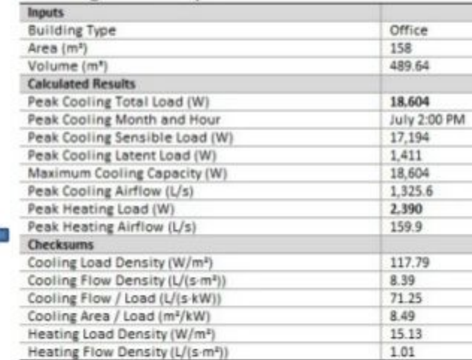
4. Heating and Cooling Load Calculations



Heating and Cooling Loads

Parameter	Value
Building Type	Office
Location	Jeddah Saudi Arabia
Building Service	Constant Volume - Varia
Building Construction	<Building>
Building Infiltration Class	None
Report Type	Standard
Ground Plane	Level 1
Project Phase	New Construction
Sliver Space Tolerance	304.8
Use Load Credits	☐

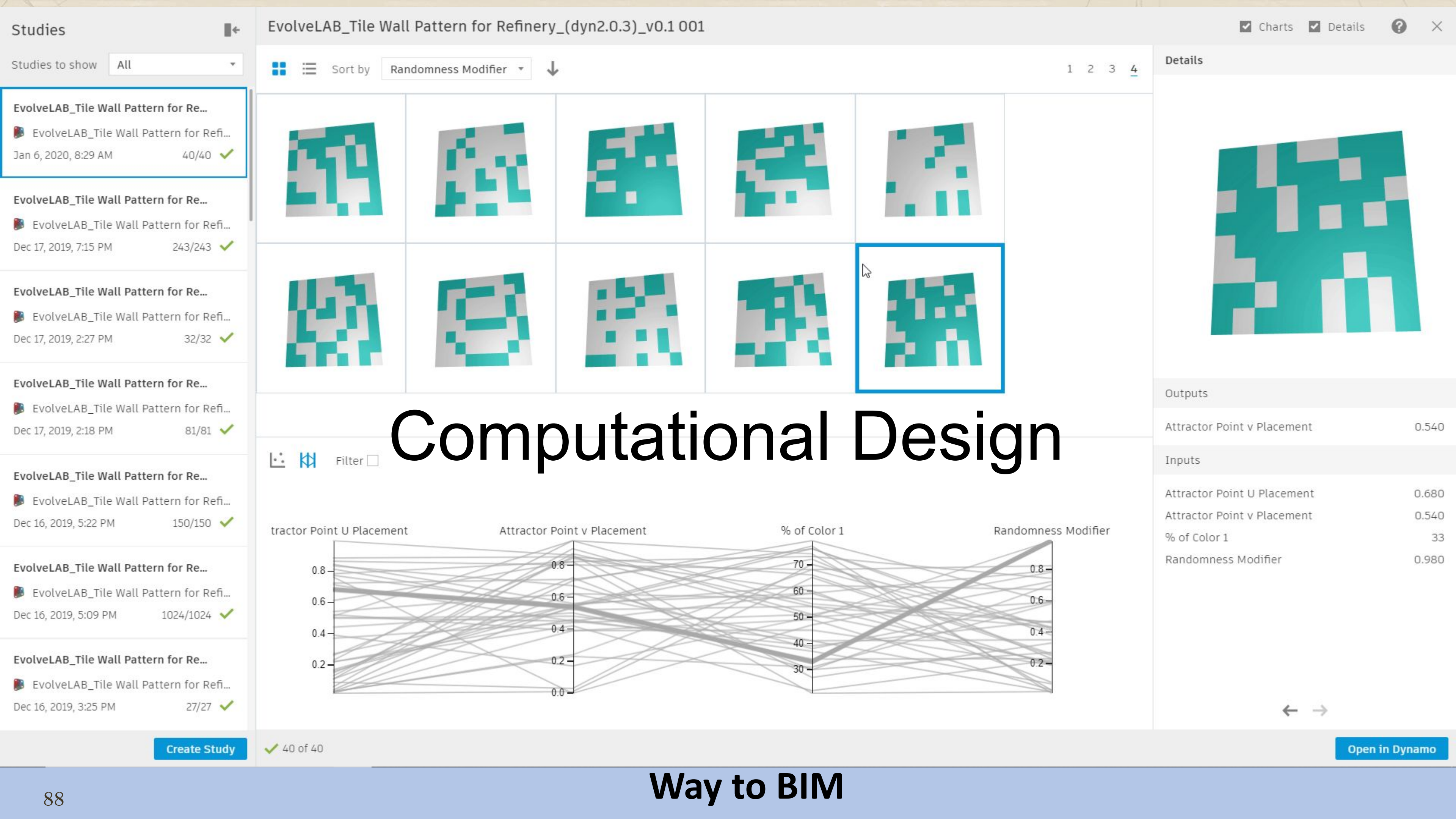




Inputs	
Building Type	Office
Area (m^2)	158
Volume (m^3)	489.64
Calculated Results	
Peak Cooling Total Load (W)	**18,604**
Peak Cooling Month and Hour	July 2:00 PM
Peak Cooling Sensible Load (W)	17,194
Peak Cooling Latent Load (W)	1,411
Maximum Cooling Capacity (W)	18,604
Peak Cooling Airflow (L/s)	1,325.6
Peak Heating Load (W)	**2,390**
Peak Heating Airflow (L/s)	159.9
Checksums	
Cooling Load Density (W/m^2)	117.79
Cooling Flow Density (L/(s·m^2))	8.39
Cooling Flow / Load (L/(s·kW))	71.25
Cooling Area / Load (m^2/kW)	8.49
Heating Load Density (W/m^2)	15.13
Heating Flow Density (L/(s·m^2))	1.01

Spaces

Space Name	Area (m^2)	Volume (m^3)	Peak Cooling Load (W)	Cooling Airflow (L/s)	Peak Heating Load (W)	Heating Airflow (L/s)
1 Common	56	174.15	3,544	259.5	703	47.0
2 Office 1	7	20.92	1,014	74.3	157	10.5
3 Office 2	7	23.25	960	70.3	121	8.1
4 Office 3	7	22.48	930	68.1	117	7.8
5 Office 4	8	23.81	982	71.9	124	8.3
7 Office 7	7	22.61	1,055	77.2	165	11.0
8 Office 6	8	24.27	1,007	73.7	119	8.0
9 Washroom	6	19.78	721	52.8	96	6.4
10 Office 5	13	41.35	1,792	131.2	248	16.6
11 Department Manager	4	12.37	471	34.5	115	7.7
12 Department	34	104.64	5,623	411.8	425	28.5



Studies
Studies to show
All
EvolveLAB_Tile Wall Pattern for Re...
EvolveLAB_Tile Wall Pattern for Refi...
Jan 6, 2020, 8:29 AM
40/40
EvolveLAB_Tile Wall Pattern for Re...
EvolveLAB_Tile Wall Pattern for Refi...
Dec 17, 2019, 7:15 PM
243/243
EvolveLAB_Tile Wall Pattern for Re...
EvolveLAB_Tile Wall Pattern for Refi...
Dec 17, 2019, 2:27 PM
32/32
EvolveLAB_Tile Wall Pattern for Re...
EvolveLAB_Tile Wall Pattern for Refi...
Dec 17, 2019, 2:18 PM
81/81
EvolveLAB_Tile Wall Pattern for Re...
EvolveLAB_Tile Wall Pattern for Refi...
Dec 16, 2019, 5:22 PM
150/150
EvolveLAB_Tile Wall Pattern for Re...
EvolveLAB_Tile Wall Pattern for Refi...
Dec 16, 2019, 5:09 PM
1024/1024
EvolveLAB_Tile Wall Pattern for Re...
EvolveLAB_Tile Wall Pattern for Refi...
Dec 16, 2019, 3:25 PM
27/27
Create Study
EvolveLAB_Tile Wall Pattern for Refinery_(dyn2.0.3)_v0.1 001
Charts
Details
Sort by
Randomness Modifier
1 2 3 4
Computational Design
Filter
tractor Point U Placement
Attractor Point v Placement
% of Color 1
Randomness Modifier
40 of 40
Details
Outputs
Attractor Point v Placement 0.540
Inputs
Attractor Point U Placement 0.680
Attractor Point v Placement 0.540
% of Color 1 33
Randomness Modifier 0.980
Open in Dynamo
Way to BIM

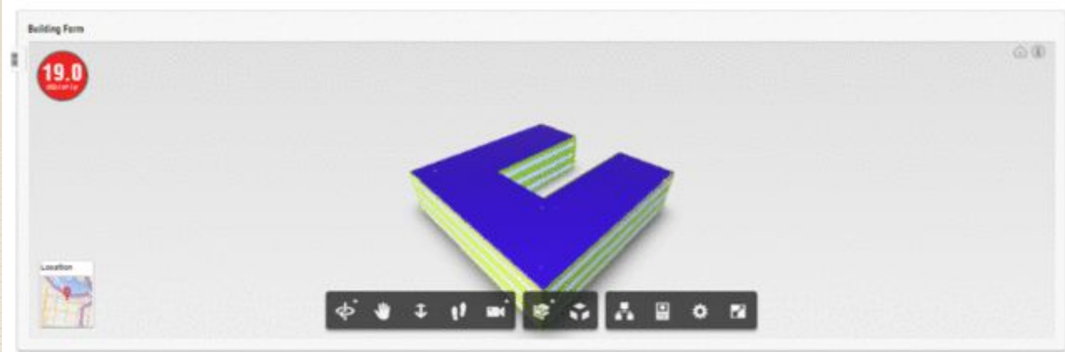
EXTERNAL TO REVIT

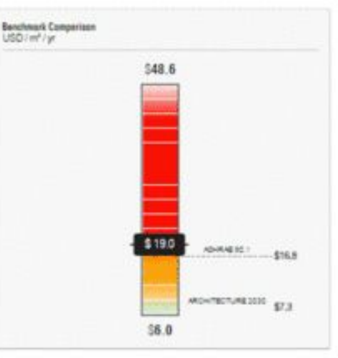
- Insight 360

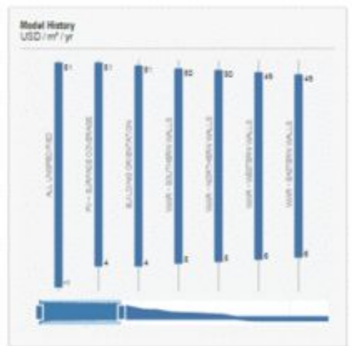
New cloud-based tool enabling a new way to experience building energy and environmental performance and the collective actions that lead to better outcomes throughout all stages of the building lifecycle.

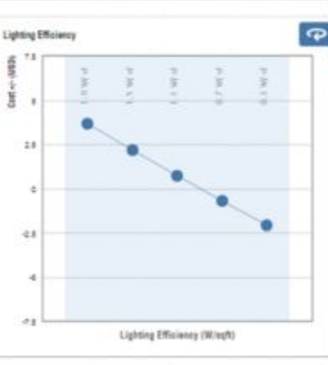
https://insight.autodesk.com/OneEnergy/Model/128869

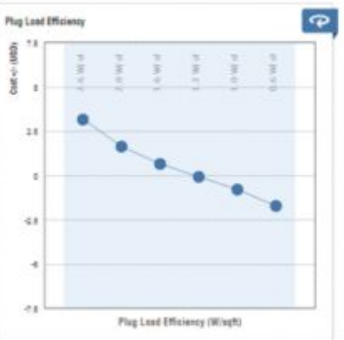


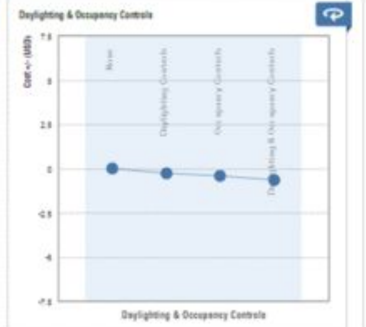


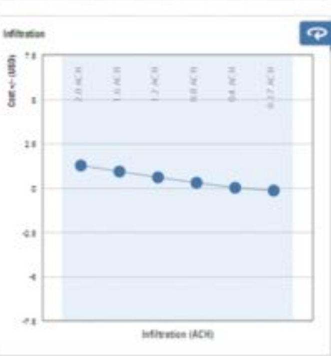


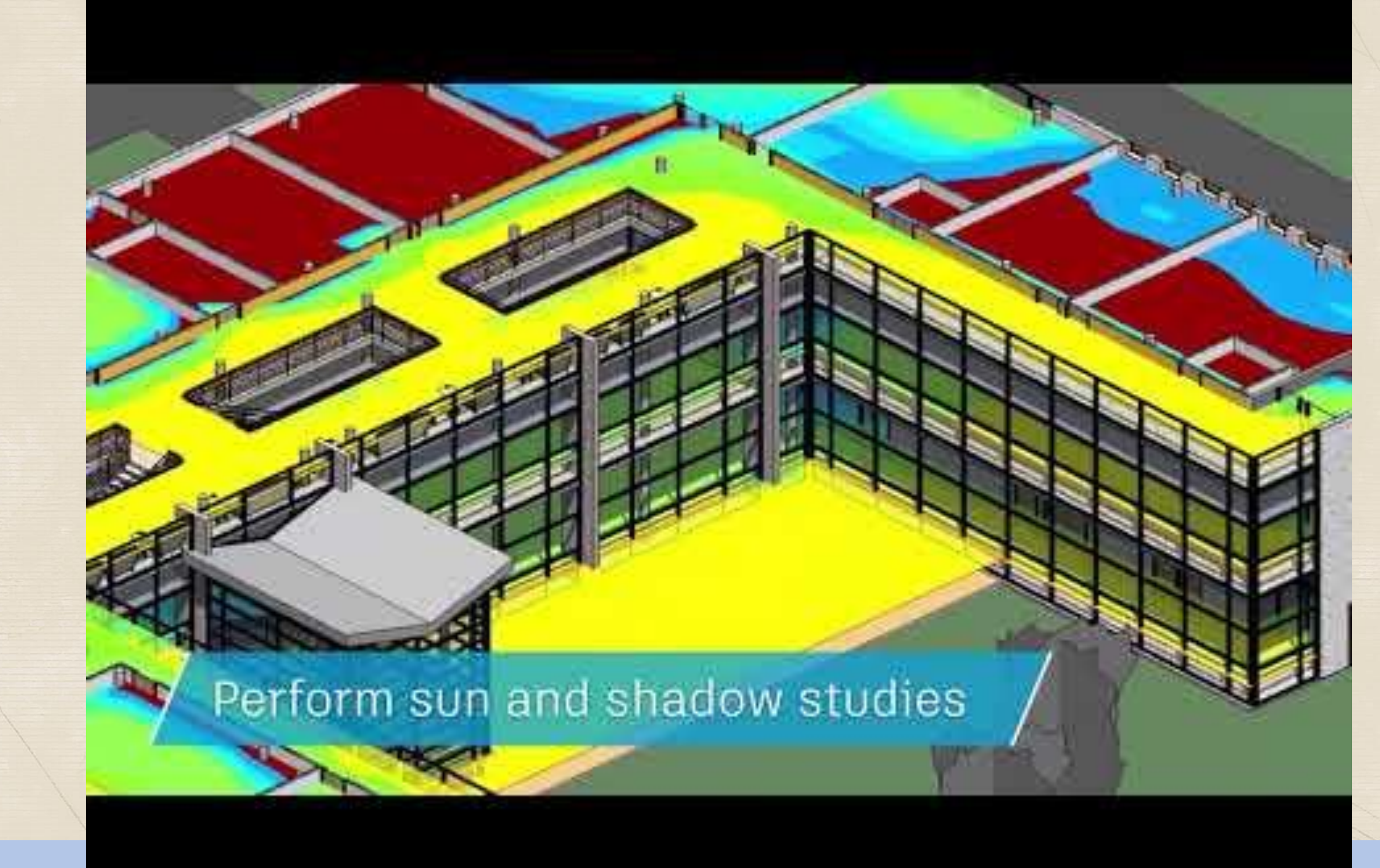











Perform sun and shadow studies

Insight 360

- Solar Analysis

Visualize and quantify the distribution of solar radiation on various surfaces.

- Light Analysis

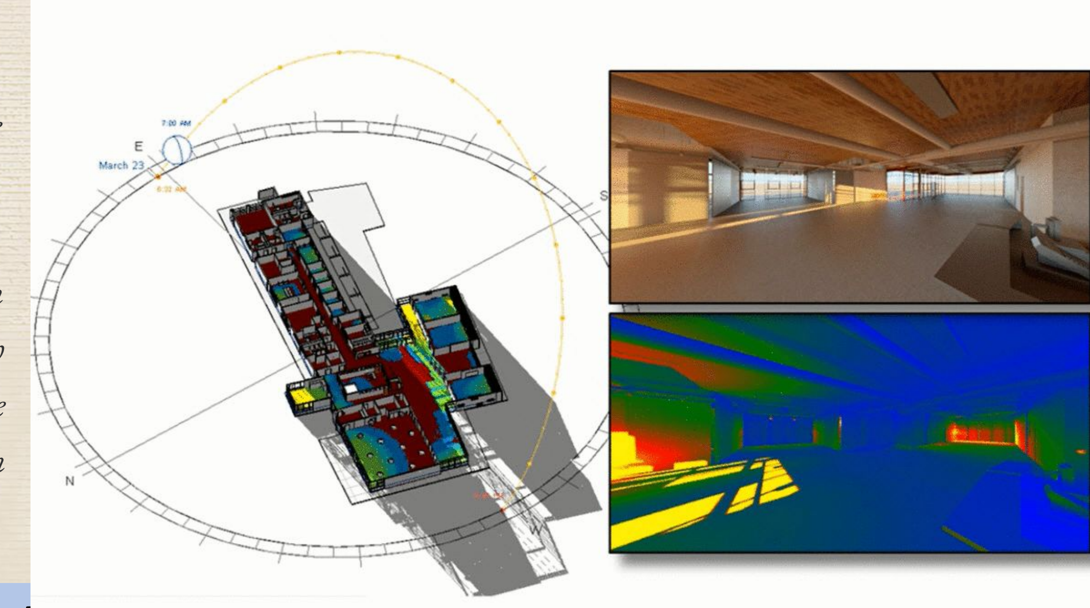
Analysis for illuminance and validation for LEED v3 IEQc8.1 and LEED v4 IEQ Daylight Credit, Option 2.

- Heating and Cooling Loads

Tool used primarily by mechanical engineers to size HVAC equipment.

- Generate Insight

Automatically varies building design inputs resulting in high and low possible annual energy costs with approximately +/- 10% accuracy. Inputs can then be adjusted, e.g., glazing properties, to see instant feedback on performance impacts.



Software

EXTERNAL TO REVIT

- Green Building Studio (GBS)
- Standalone cloud-based whole building performance analysis using the DOE2 simulation engine.
  - Web-based solution
  - Early building energy design decisions
  - Whole building energy analysis
  - Design alternative comparisons
- https://gbs.autodesk.com/GBS/Project

Building Summary
Quick Stats
Specific Fan Flow 1.7 LPerSec/m²
Specific Cooling 27 m²/kW
Specific Heating 13 m²/kW
Total Fan Flow 12,431 LPerSec
Total Cooling Capacity 274 kW
Total Heating Capacity 568 kW
Constructions
Roofs
R15 over Roof Deck 2,424 m²
Ceilings
Interior Drop Ceiling Tile 4,848 m²
Exterior Walls
R2 CMU Wall 1,100 m²
Interior Walls
R0 Metal Frame Wall 560 m²
Underground Walls
R7.5 8" CMU UnderGnd Wall 550 m²
Underground Slabs
Interior 4" Slab Floor 2,424 m²
Nonsliding Doors
R2 Default Door (6 doors) 15 m²
Fixed Windows
Dbl Green 6/6 Air (7 windows) 9 m²
Hydronic Equipment
Note: The information below should not be used for sizing purposes.
Domestic Hot Water
Water Heater Capacity 31,651,678 Joules
Air Equipment
Note: The information below should not be used for sizing purposes.
Packaged Single Zone
Cooling Capacity 58 Kilowatt
Heating Capacity 116 Kilowatt
Supply Fan Flow 2,736 LPerSec

General Information
Project Title: Large Hospital
Run Title: Example
Building Type: Office
Building Location: 94104
Floor Area: 7,272 m²

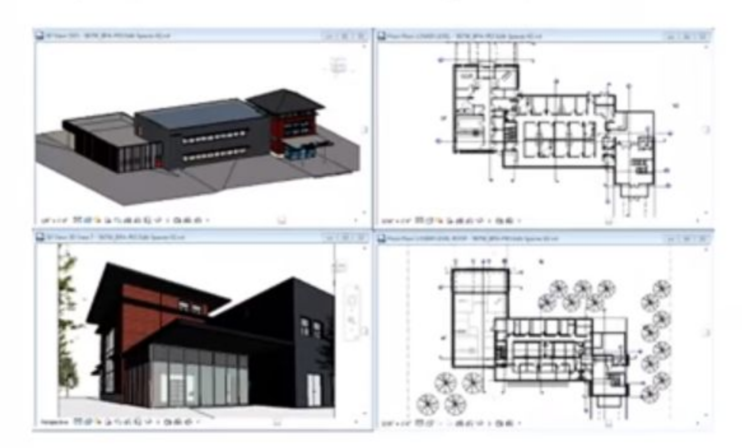
Estimated Energy & Cost Summary
Annual Energy Cost $117,642
Lifecycle* Cost $1,602,289
Annual Energy
Electric 1,107,346 kWh
Fuel 811,654 MJ
Annual Peak Electric Demand 275.4 kW
Lifecycle* Energy
Electric 33,220,380 kWh
Fuel 24,349,625 MJ
* 30-year life and 6.1 % discount rate for costs

Energy End-Use Charts
Click on chart for more or less detail.
Annual Electric End Use
HVAC 14.4%
Lights 40.4%
Other 45.2%

GREENBUILDINGSTUDIO

Climate Analysis using Autodesk Green Building Studio

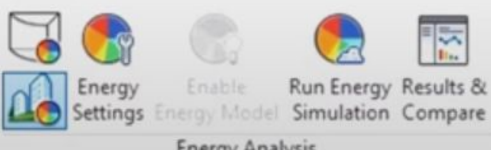
Step 1 :-Create the Revit building model.



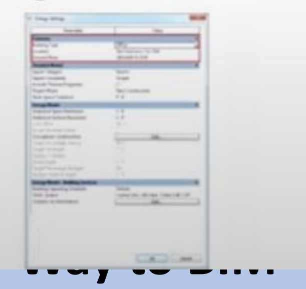
Step 2:- To use this feature, you must sign in to Autodesk 360



Step 3:- Set building elements as the basis for the energy simulation.



Step 4:-Specify the building energy settings as needed



Step 5:- Run the Energy Simulation.

Output:

- Customizable charts for
- Heating Loads
- Cooling Loads
- Estimated Energy End Use
- Energy Cost
- Dry Bulb Temperature
- Wind Data

- Customizable Parametric Studies
- Annual carbon footprint specific to region and utility mix
- Renewable energy potential (photovoltaic and wind)
- Weather data summary and user defined graphics
- Building and site specific natural ventilation potential
- US EPA ENERGY STAR
- Water preliminary analysis for LEED
- Building summary of construction areas, equipment capacities, etc.
- gbXML file for import to Trane TRACE 700 or other gbXML-compliant tools
- DOE-2.2 file for import to eQUEST
- EnergyPlus IDF file for editing and running in EnergyPlus
- VRML file
- Design Review file

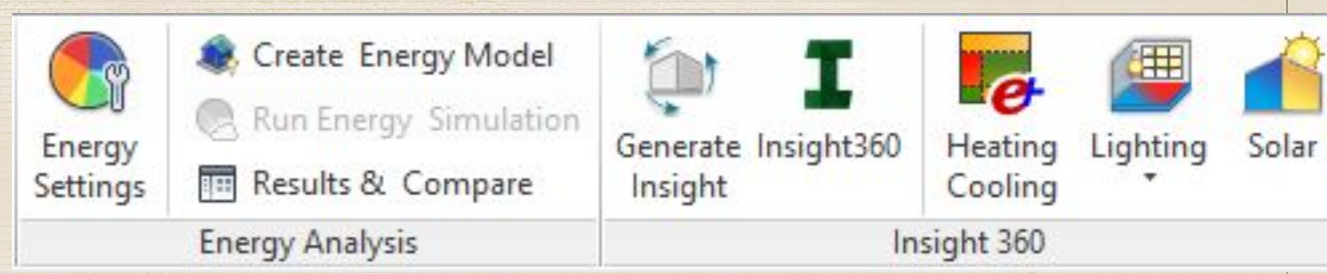
Within Revit

- Energy Analysis

Analyze a design's expected energy use based on geometry and location on earth.

Energy Settings dialog (**Analysis** tab)

- Set Location
- Select Project Phase
- Specify **Analysis Mode:** Avoid *Use Conceptual Masses* setting)
- All other settings are optional



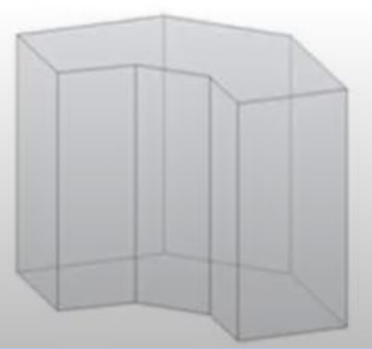
Energy Analysis tools on the Analysis tab in Revit 2016 R2, plus the Insight 360 add-in.

Steps for Performing Conceptual Energy Analysis

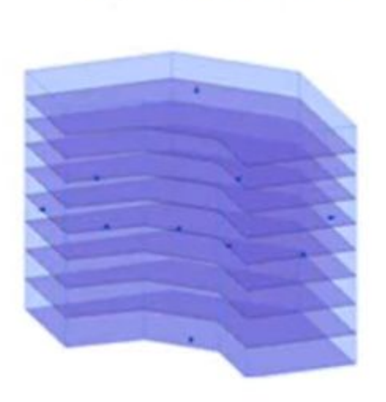
Step 1:- To use this feature, you must sign in to Autodesk 360



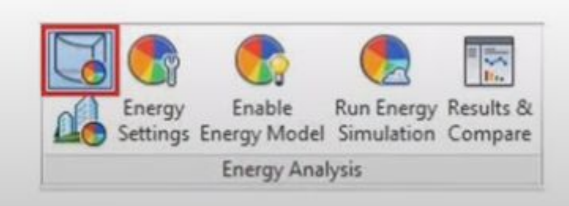
Step 2:-Create a mass model.



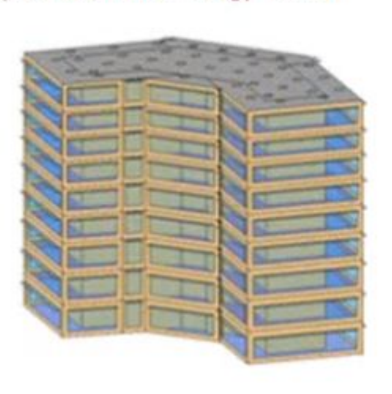
Step 3:- Add mass floors.



Step 4:- Set conceptual masses as the basis for the energy simulation.



Step 5:- Create the energy model

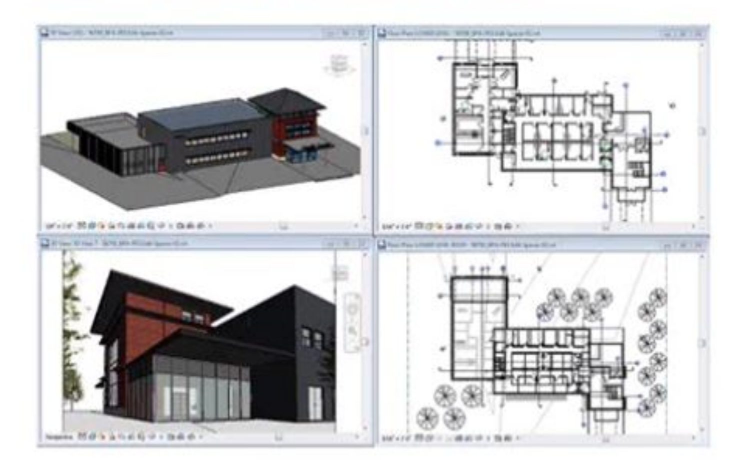


Step 6:- Run the Energy Simulation.



Steps for Performing Energy Analysis using Building Elements

Step 1 :-Create the Revit building model.



Step 2:- To use this feature, you must sign in to Autodesk 360



Step 5:- Run the Energy Simulation.

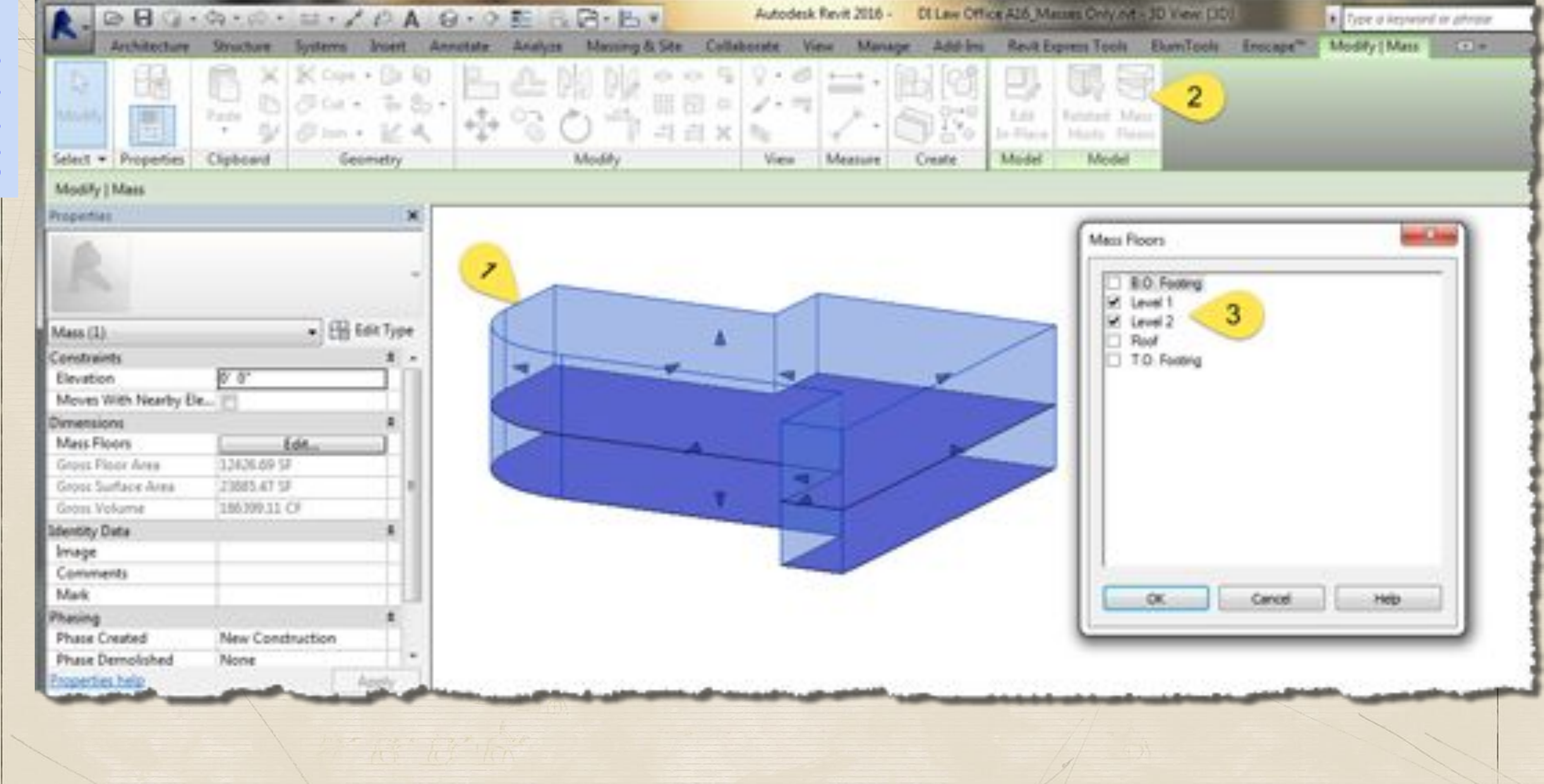


Step 3:- Set building elements as the basis for the energy simulation.

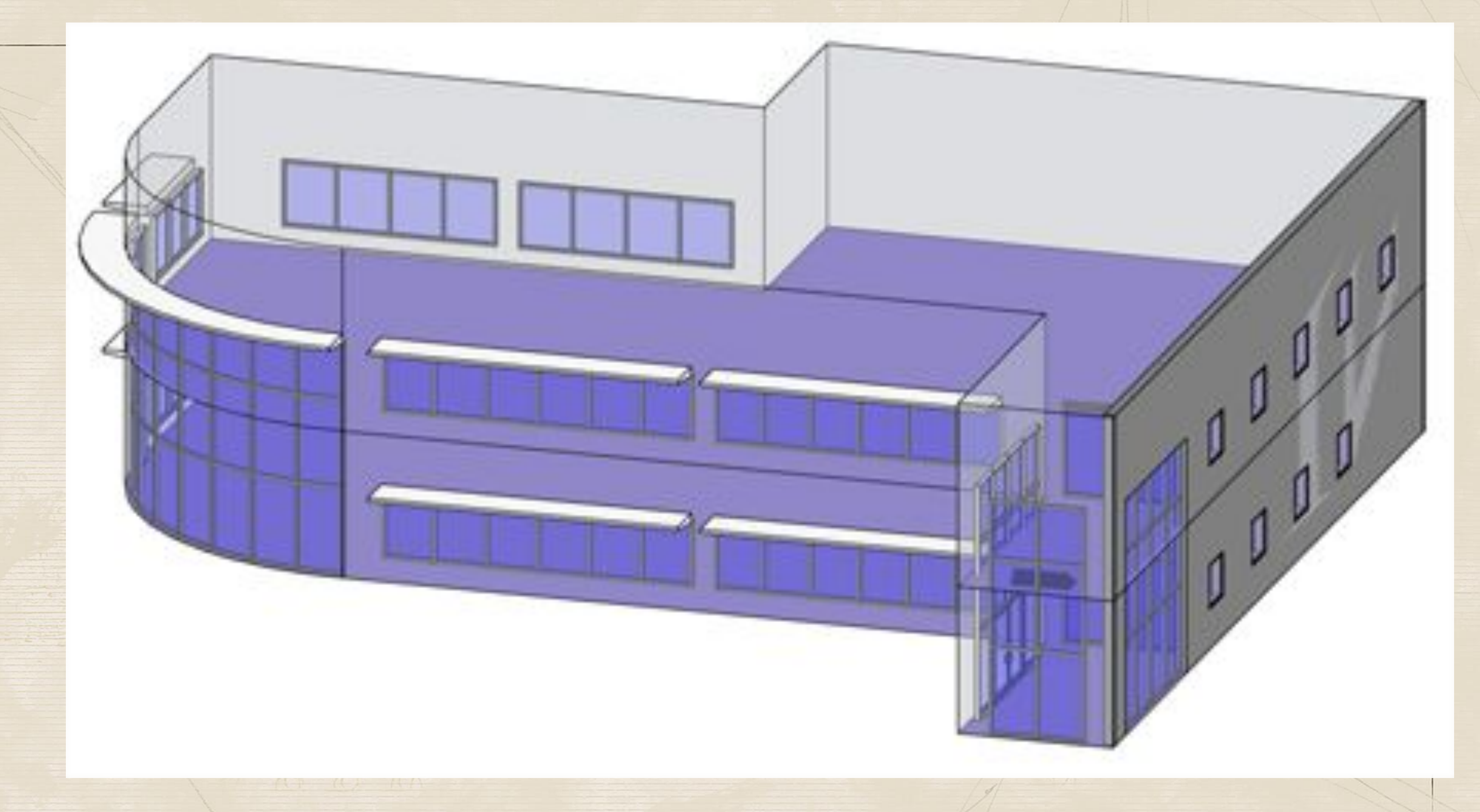


Step 4:-Specify the building energy settings as needed



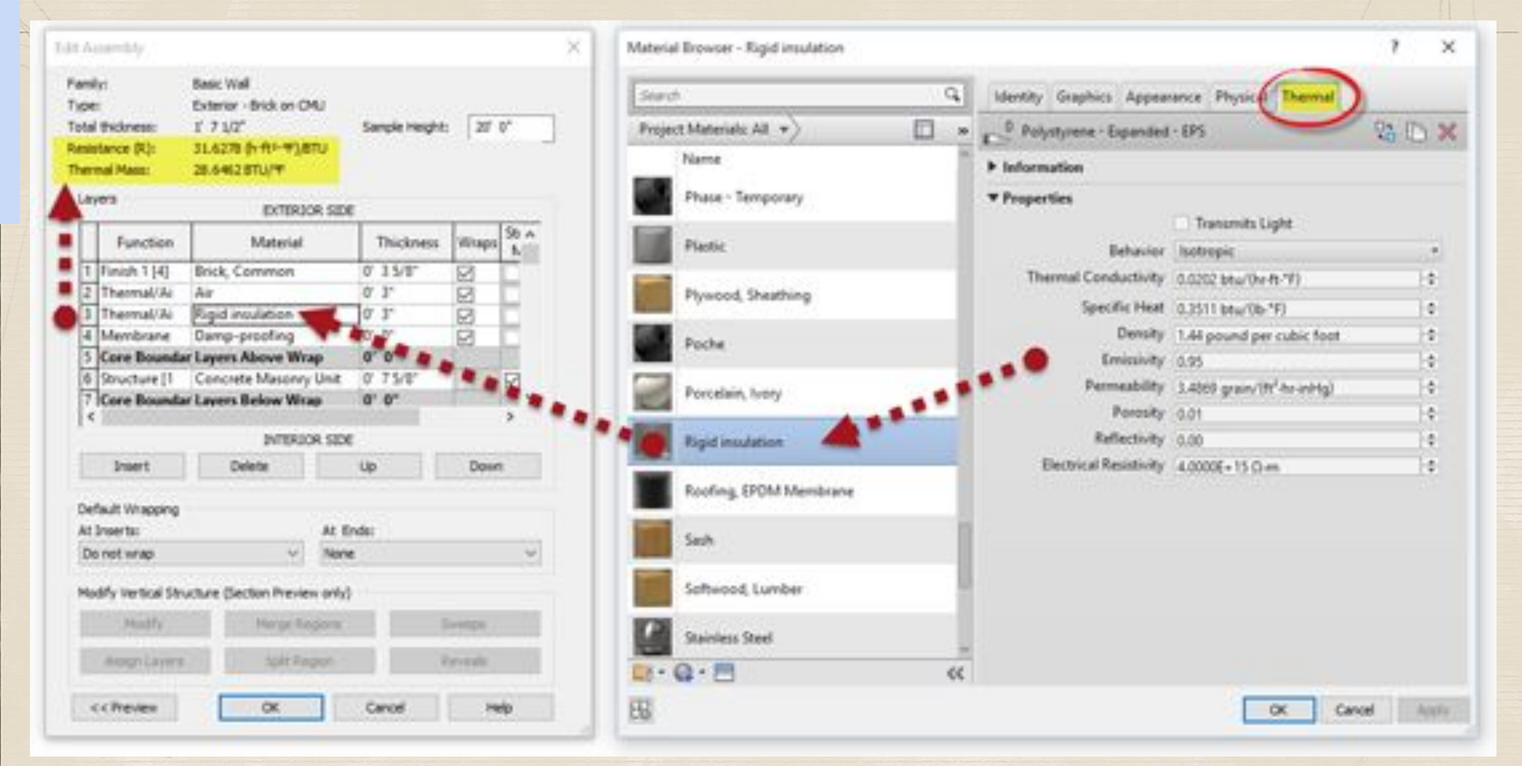


Masses must have 'mass floors' specified to create a valid EAM.

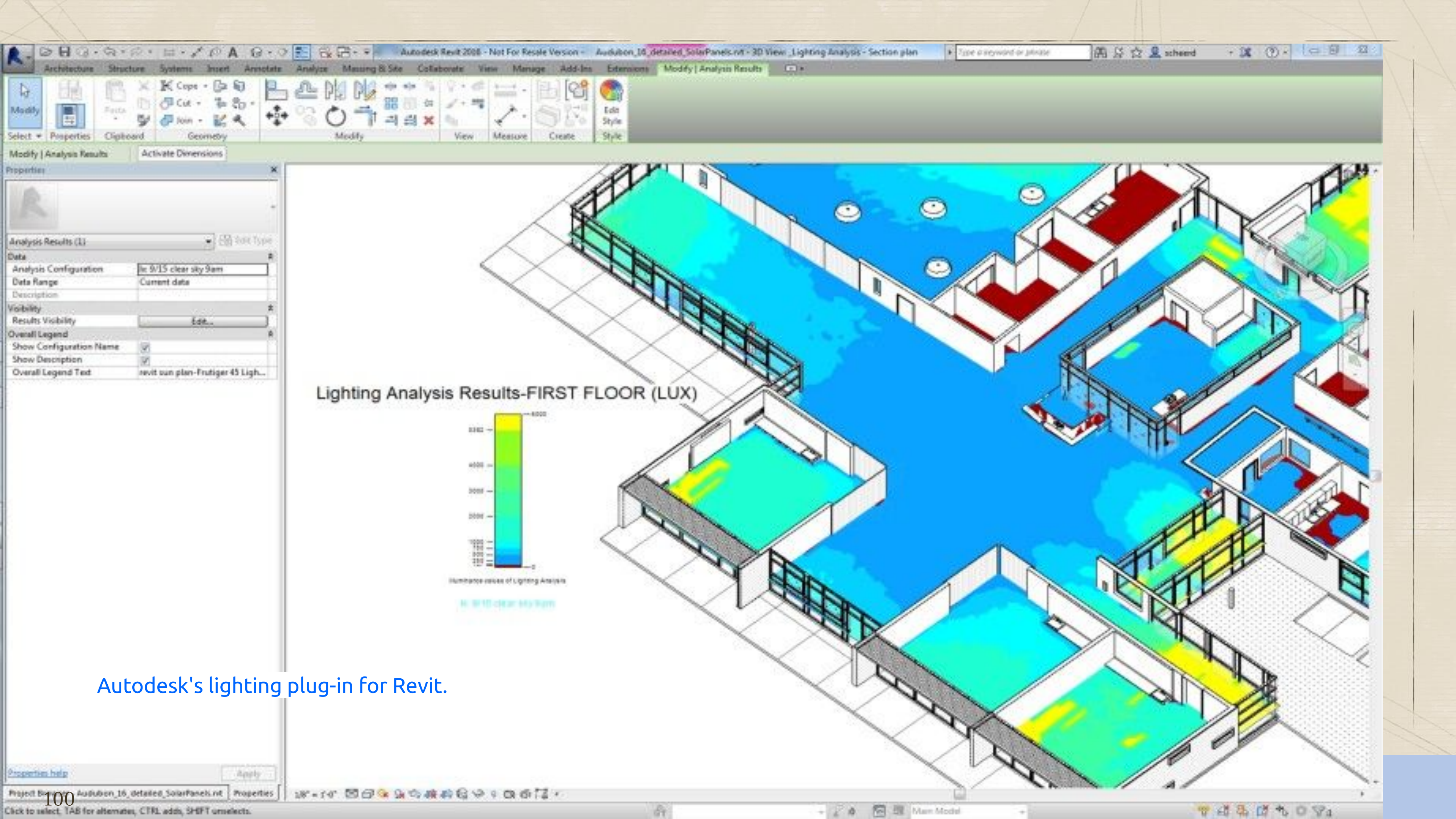


Masses and Building Elements used together in energy analysis.

Way to BIM

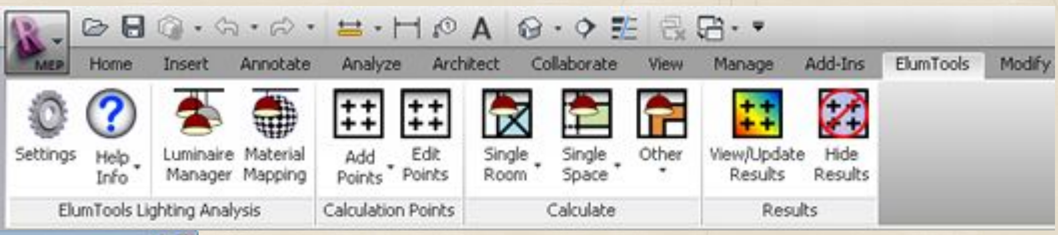


Thermal properties associated with building elements can be used in the energy simulation.



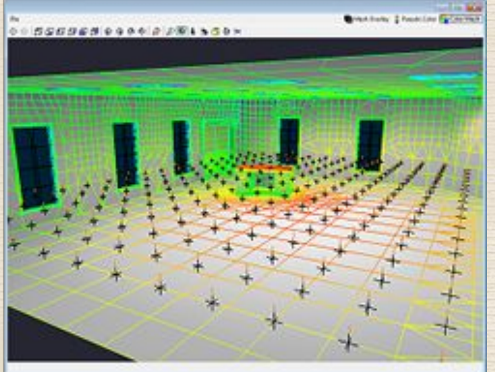
Autodesk's lighting plug-in for Revit.

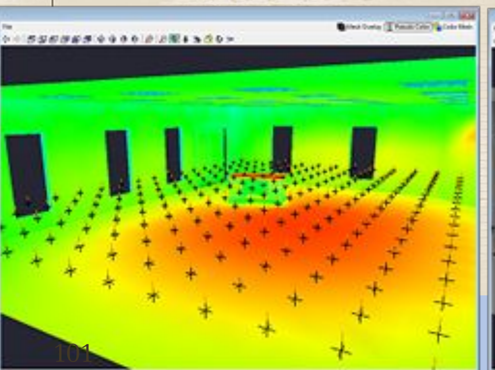
ElumTools

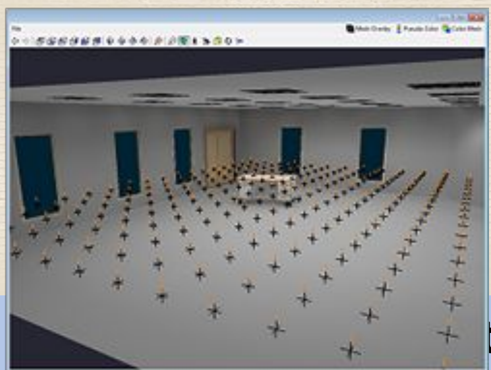


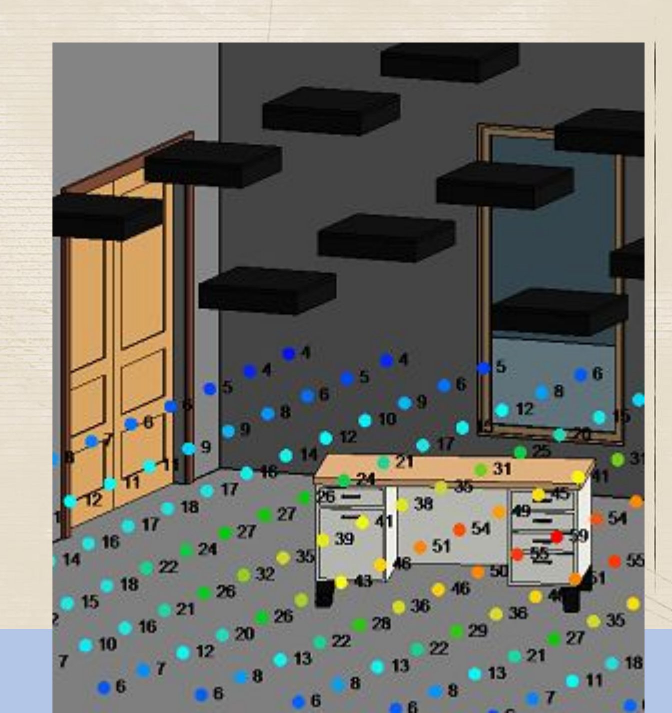
MEP
Home
Insert
Annotate
Analyze
Architect
Collaborate
View
Manage
Add-Ins
ElumTools
Modify
Settings
Help Info
Luminaire Manager
Material Mapping
Add Points
Edit Points
Single Room
Single Space
Other
View/Update Results
Hide Results
ElumTools Lighting Analysis
Calculation Points
Calculate
Results











Artificial lighting

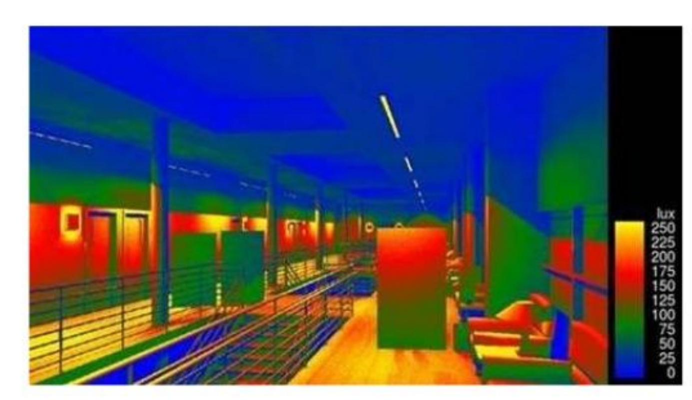
The simulations allow to calculate a series of climate-based daylight metrics such as:

- **Daylight Autonomy (DA)**
- **Useful Daylight Illuminance (UDI)**
- **Daylight Glare Probability (DGP)**
- **Daylight Factor (DF)**

Lighting Analysis

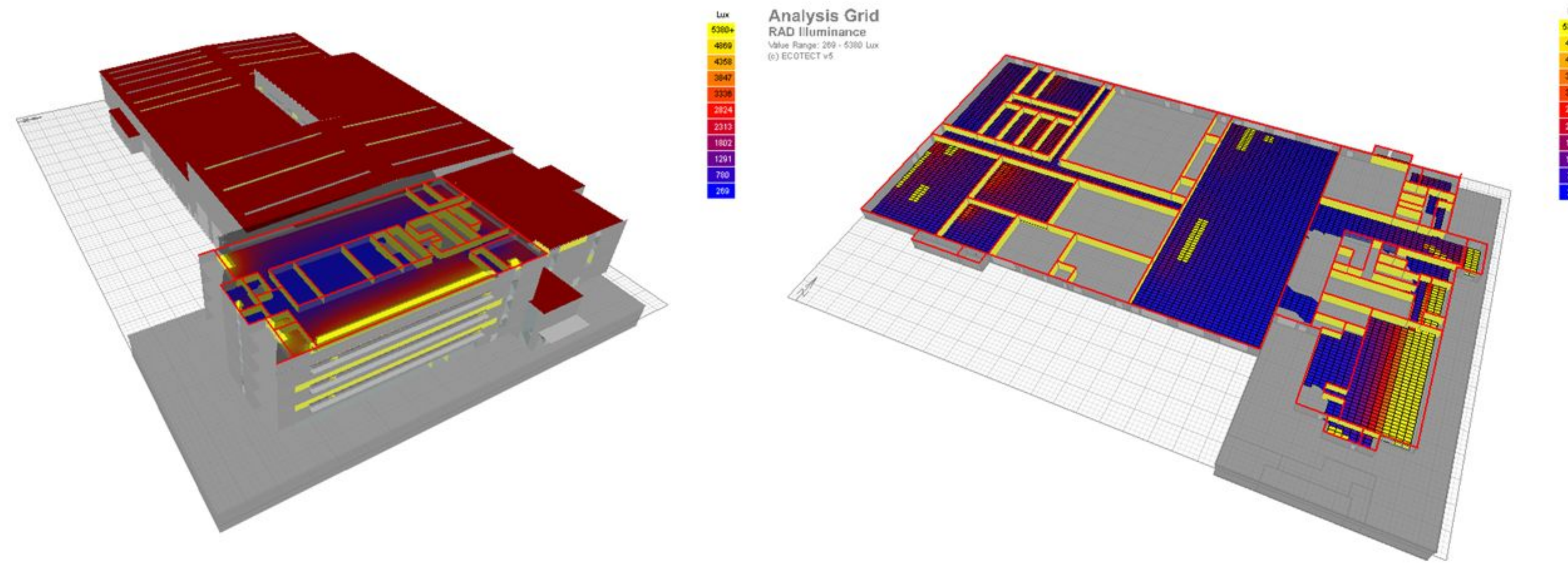


ElumTools in Revit
Calculate Point by Point



Illuminance Study
Light Distribution and Glare

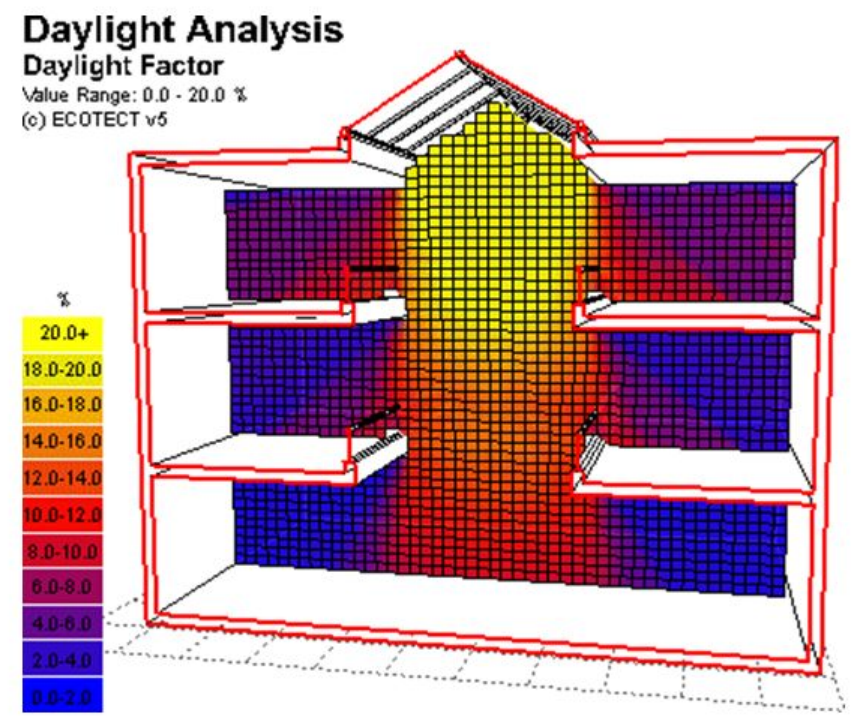
Daylighting Modeling –3D View

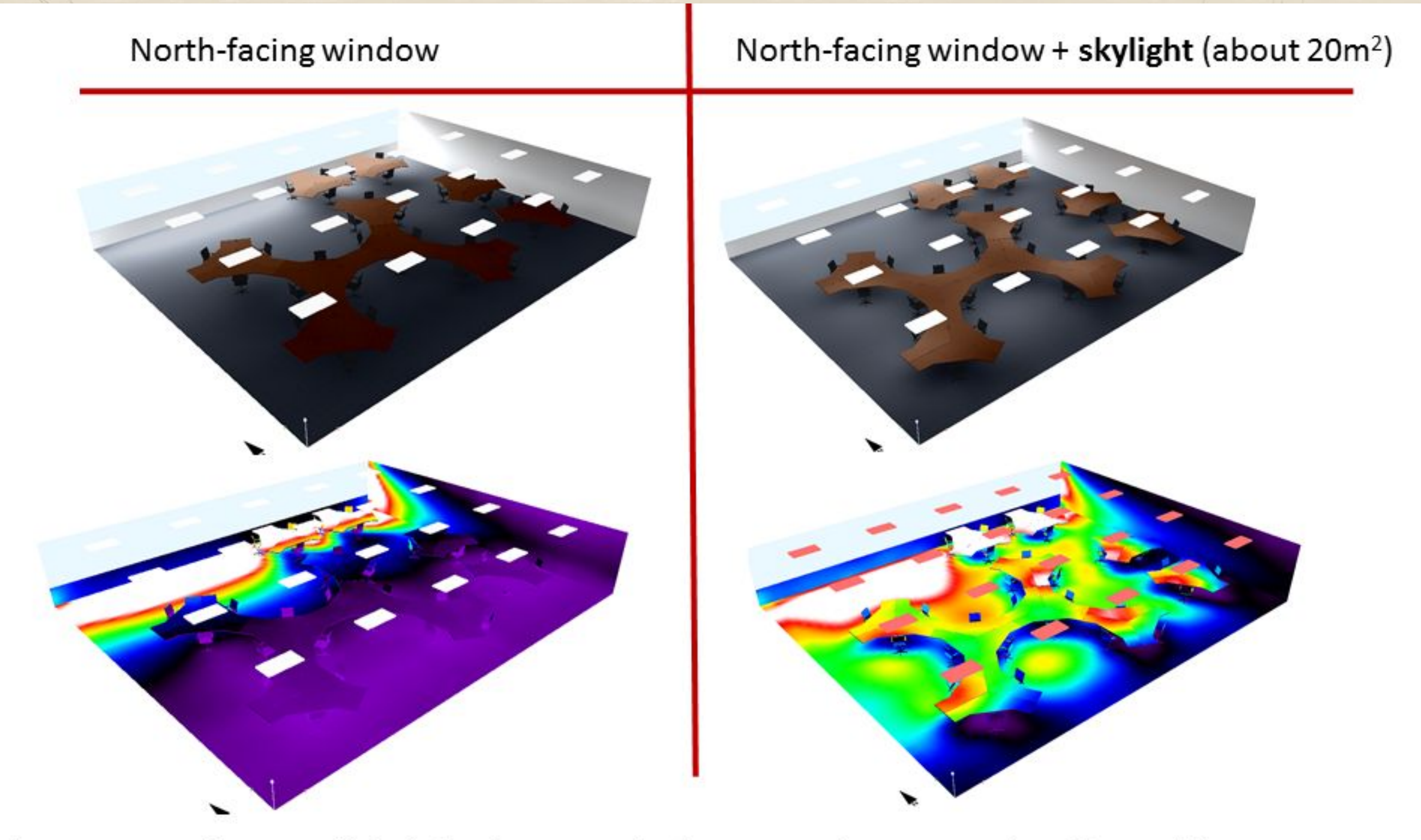


Daylighting simulation extract

Analysis Grid
RAD Illuminance
Value Range: 25 - 500 FC
(c) ECOTECT v5

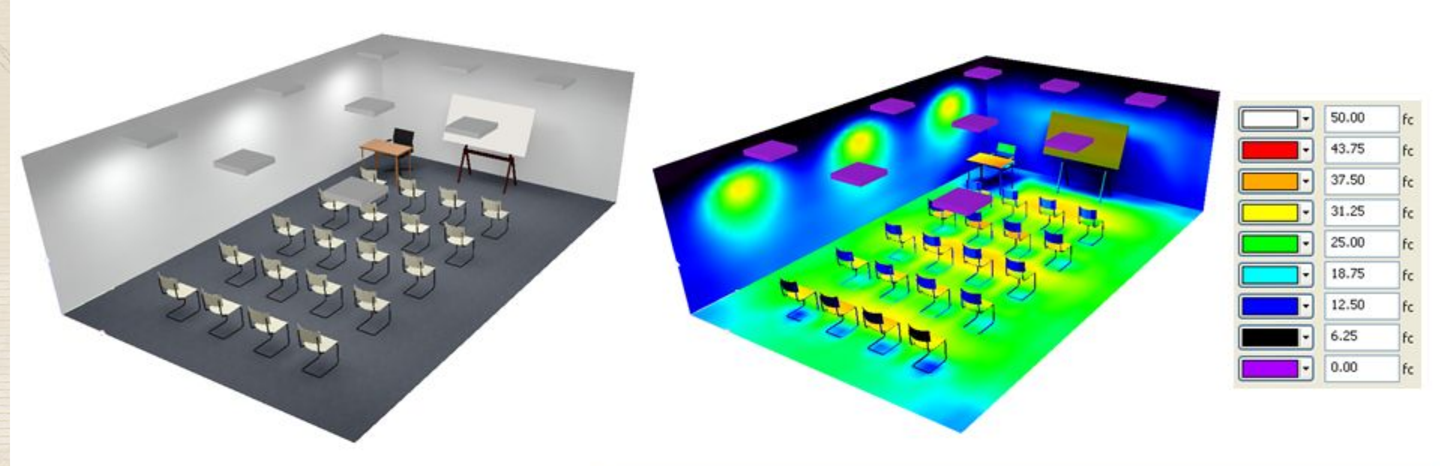
FC
500+
452
405
358
310
262
215
168
120
72
25





→Recommend to install skylight above regularly occupied spaces in the office 2nd floor

Training Room Lighting



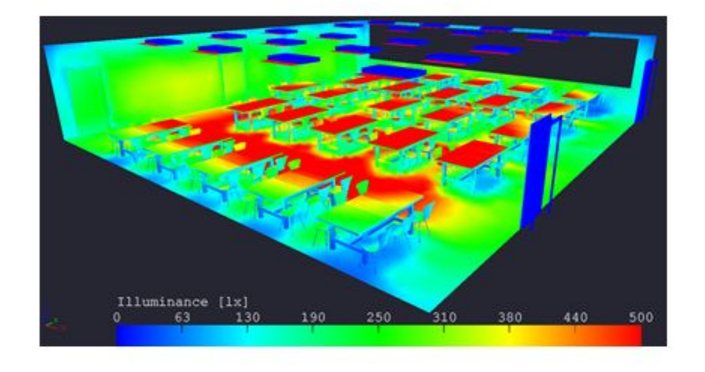
Lighting Design Example			
Fixture type	Quantity	Power (W)	Average Illumination (lux)
3x14 W	9	432	330

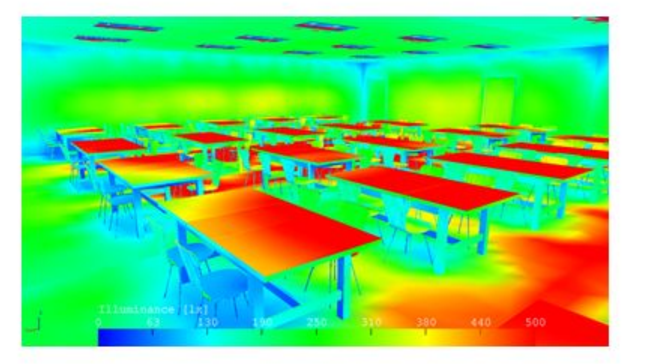
→ Installed LPD = **7.6 W/m²**

Canteen Lighting









Way to BIM



Eco Score card plug-in

Energy Simulation Plug-ins for Revit

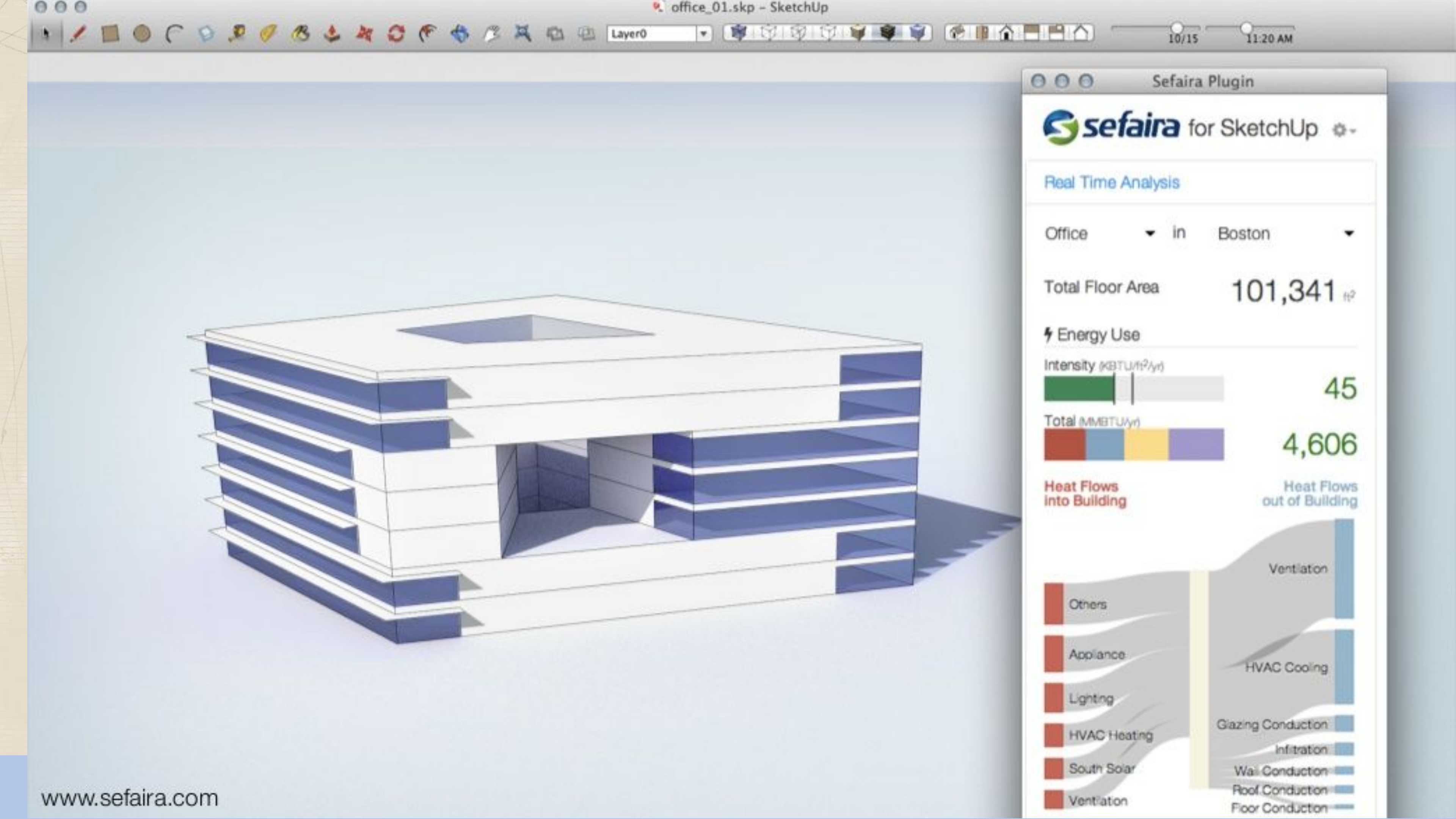
- Energy simulation plug-ins available for Revit:

  IES-VE, Design Builder and Sefaira.

- IES and Design Builder are 2 standalone energy simulation software famous among energy modelers and MEP consultants.

- Sefaira is a new player and started with energy and daylight plug-ins for Sketchup and then launched a Revit plug-in.




office_01.skp - SketchUp
Layer0
10/15
11:20 AM
Sefaira Plugin
sefaira for SketchUp
Real Time Analysis
Office
in
Boston
Total Floor Area
101,341
Energy Use
Intensity
45
Total
4,606
Heat Flows into Building
Heat Flows out of Building
Others
Appliance
Lighting
HVAC Heating
South Solar
Ventilation
Ventilation
HVAC Cooling
Glazing Conduction
Infiltration
Wall Conduction
Roof Conduction
Floor Conduction
www.sefaira.com

Tally

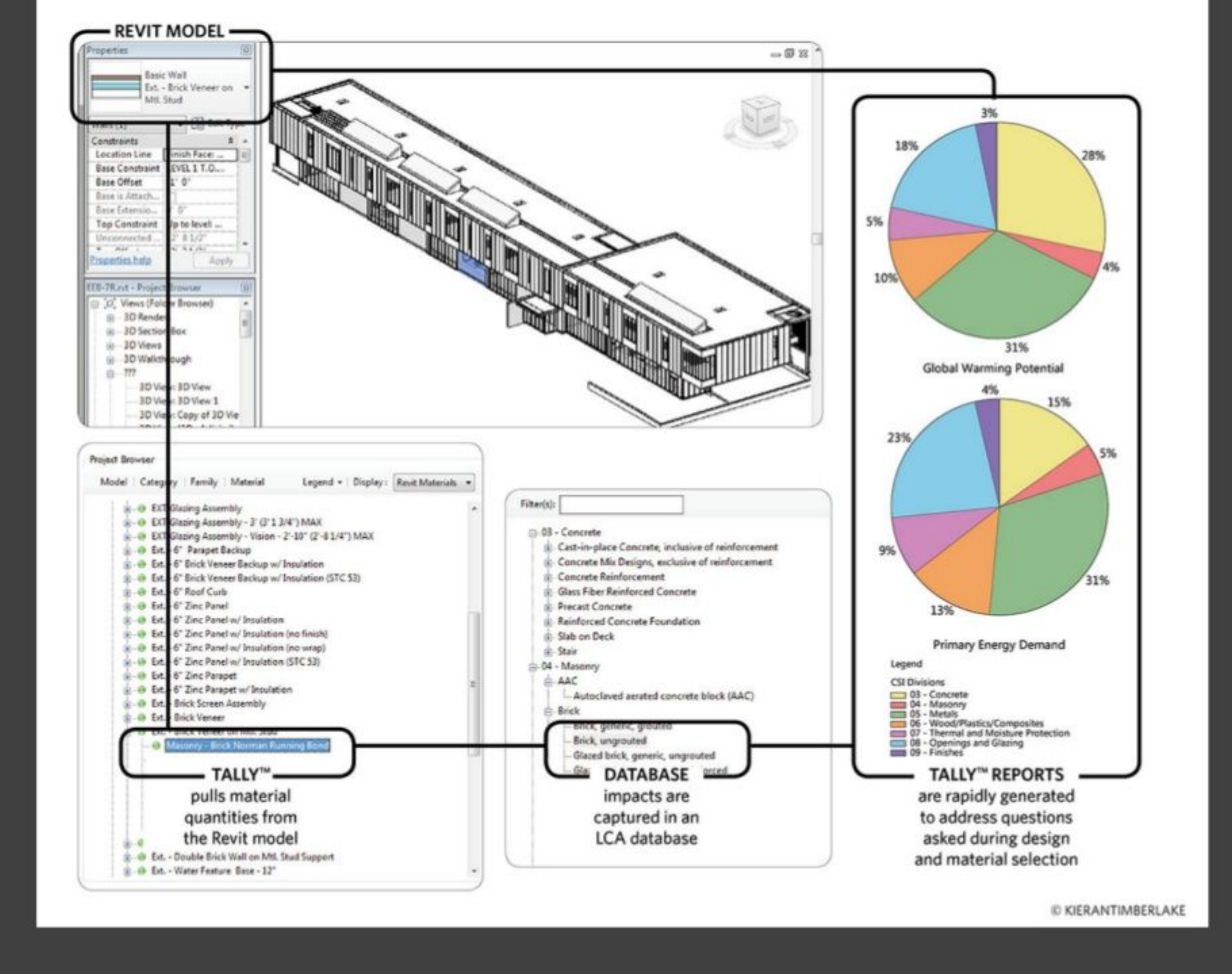


Image: www.kierantimberlake.com

Materials

- Tying BIM to materials can reduce construction waste and streamline the supply chain through more accurate procurement.
- Like carbon footprinting, it also helps us select design solutions that can reduce the overall environmental impact of a building throughout its operation. While BIM has the potential to reduce waste on all construction projects, it is highly beneficial to large complex projects, which tend to generate waste if they are not carefully managed.

Tally

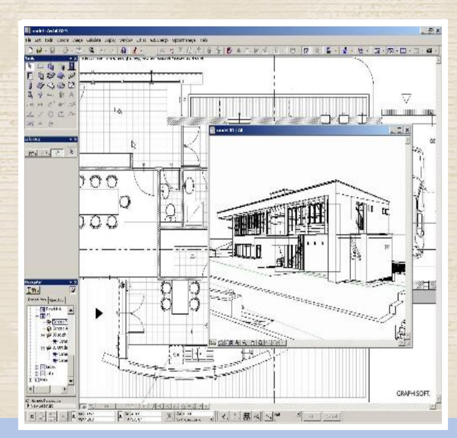
BREEAM Mat 1 Takeoff		
Material Name	Volume (m3)	Green Guide Rating
Brick - Bushbury	54.70	A+
Concrete - Cast In Situ	348.94	B
Finishes - Interior - Fermacell	4.68	A+
Insulation / Support Frame	12.00	A
Insulation / Thermal Barriers - Batt insulation	61.10	A
Insulation / Thermal Barriers - Cavity Fill	506.20	A
Insulation / Thermal Barriers - External Wall Insulation	210.16	B
Insulation / Thermal Barriers - Rigid insulation	290.78	B
Plasterboard	39.51	A+
Plastic - GRP - Glass Reinforced Plastic	1.91	B
Roofing - Metal	1.86	A


MATERIALS USE
Bley Sleeping House Addition by Agruppo. BIM model and photos by Andrew Nance.
28

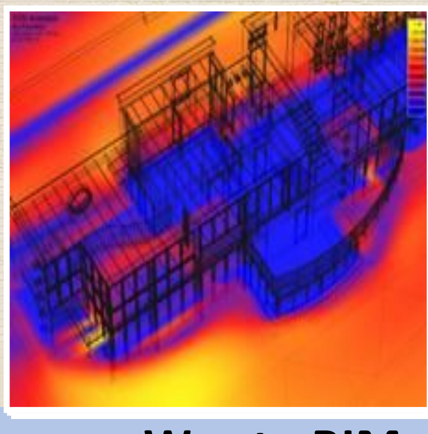
Ecodesigner "Energy Analysis with ArchiCAD"

ecodesigner

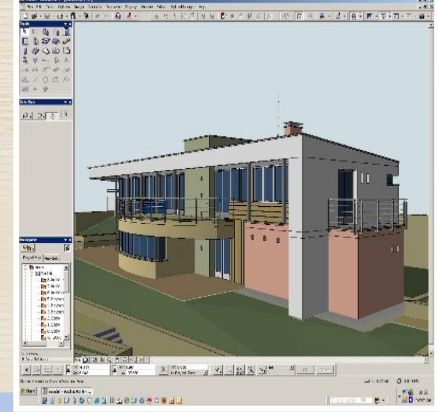
- Ease-of-use and smooth workflow
- Integrated solutions
- Evaluate alternatives early and throughout the design process



GRAPHISOFT. ARCHICAD



Energy simulation solutions



GRAPHISOFT. ARCHICAD



Detailed Energy Performance Evaluation Report

EcoDesigner STAR displays fully customizable, detailed reports about various, energy-related characteristics of the individual thermal blocks,

Supplied Energy per Week

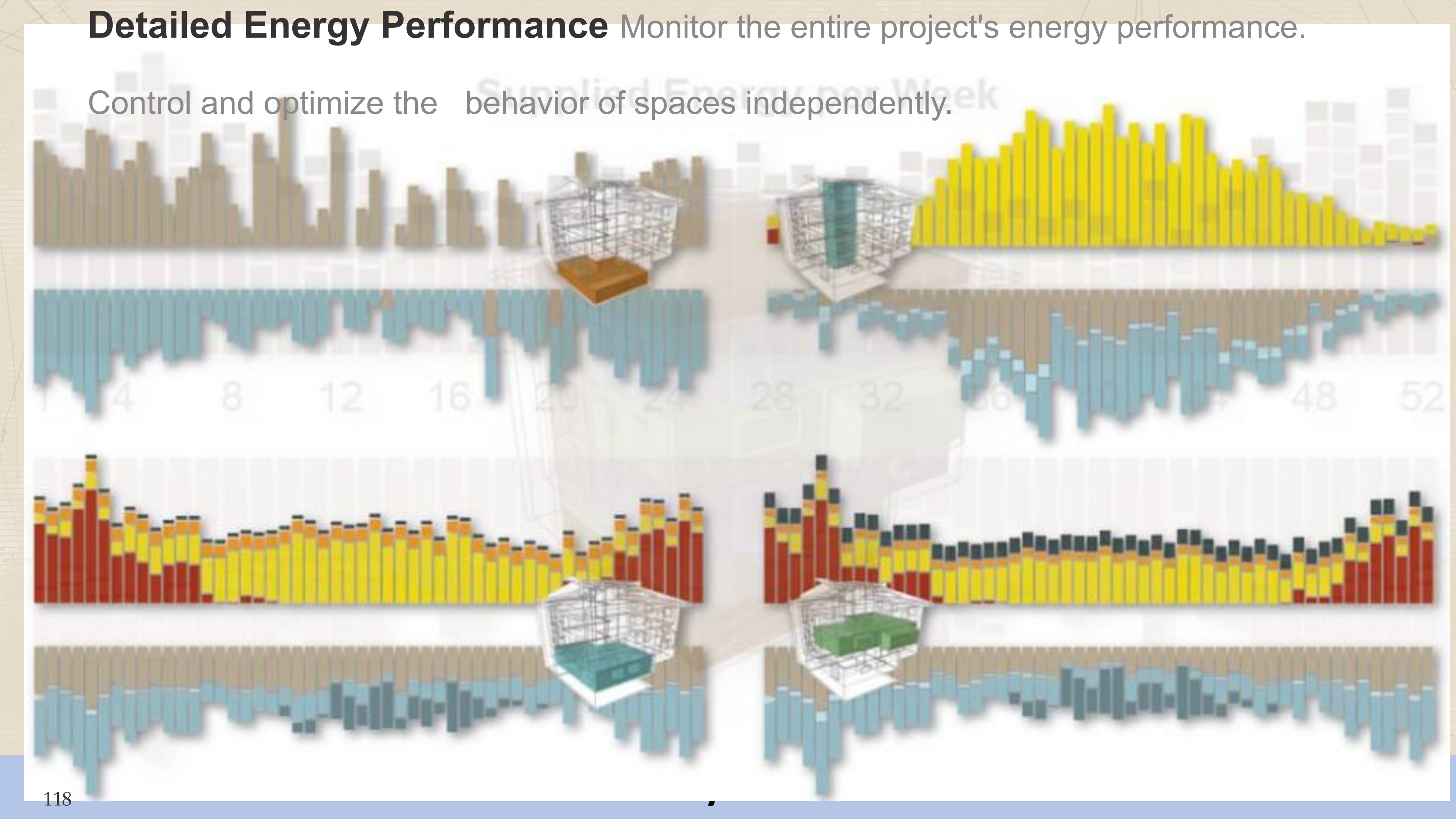
6837.8
4000
2000
0
1 4 8 12 16 20 24 28 32 36 40 44 48 52 [kWh]
0
2000
4000
6000

Emitted Energy per Week



Detailed Energy Performance Monitor the entire project's energy performance.

Control and optimize the behavior of spaces independently.



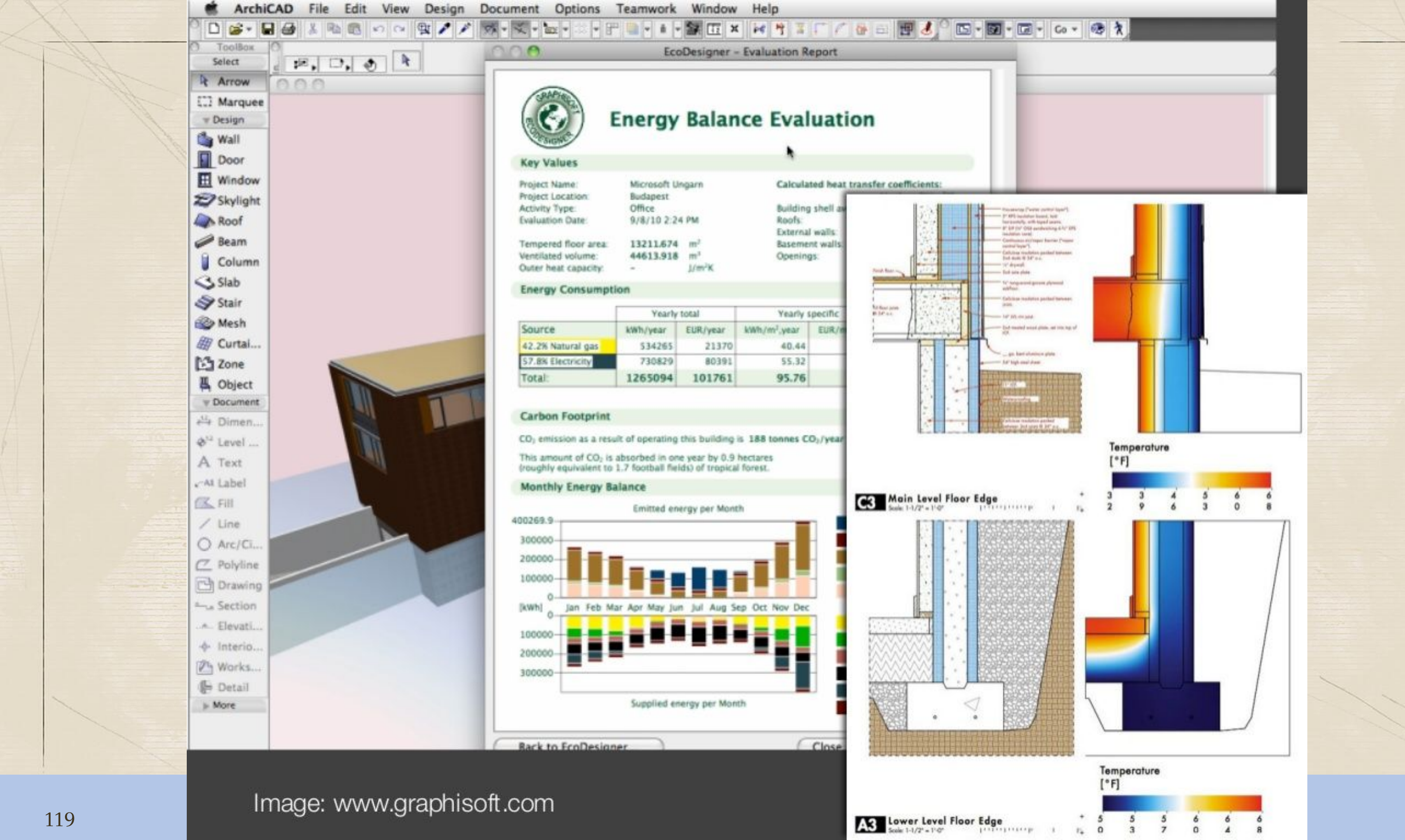
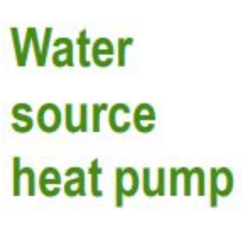
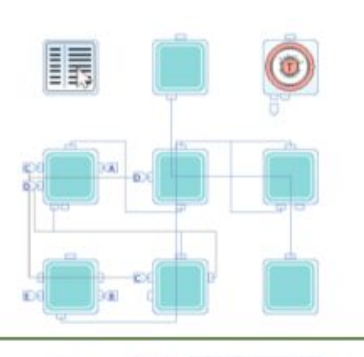


Image: www.graphisoft.com

BENTLEY

Energy analysis - AECOsim Energy Simulator

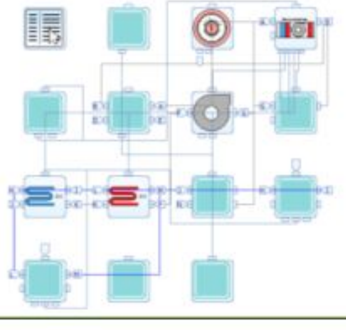






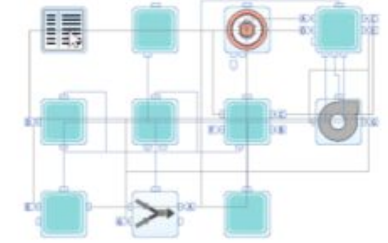


Central
VAV





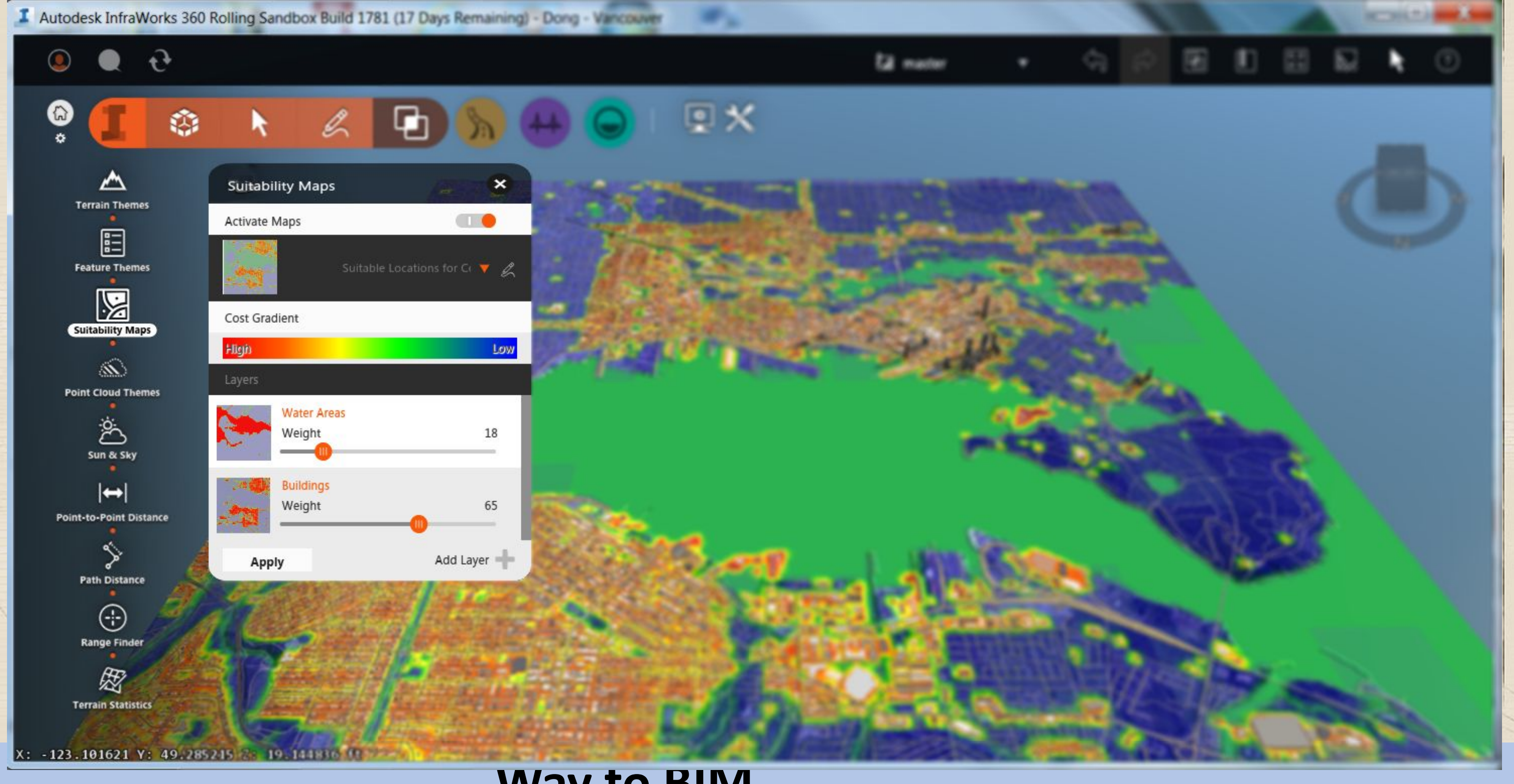




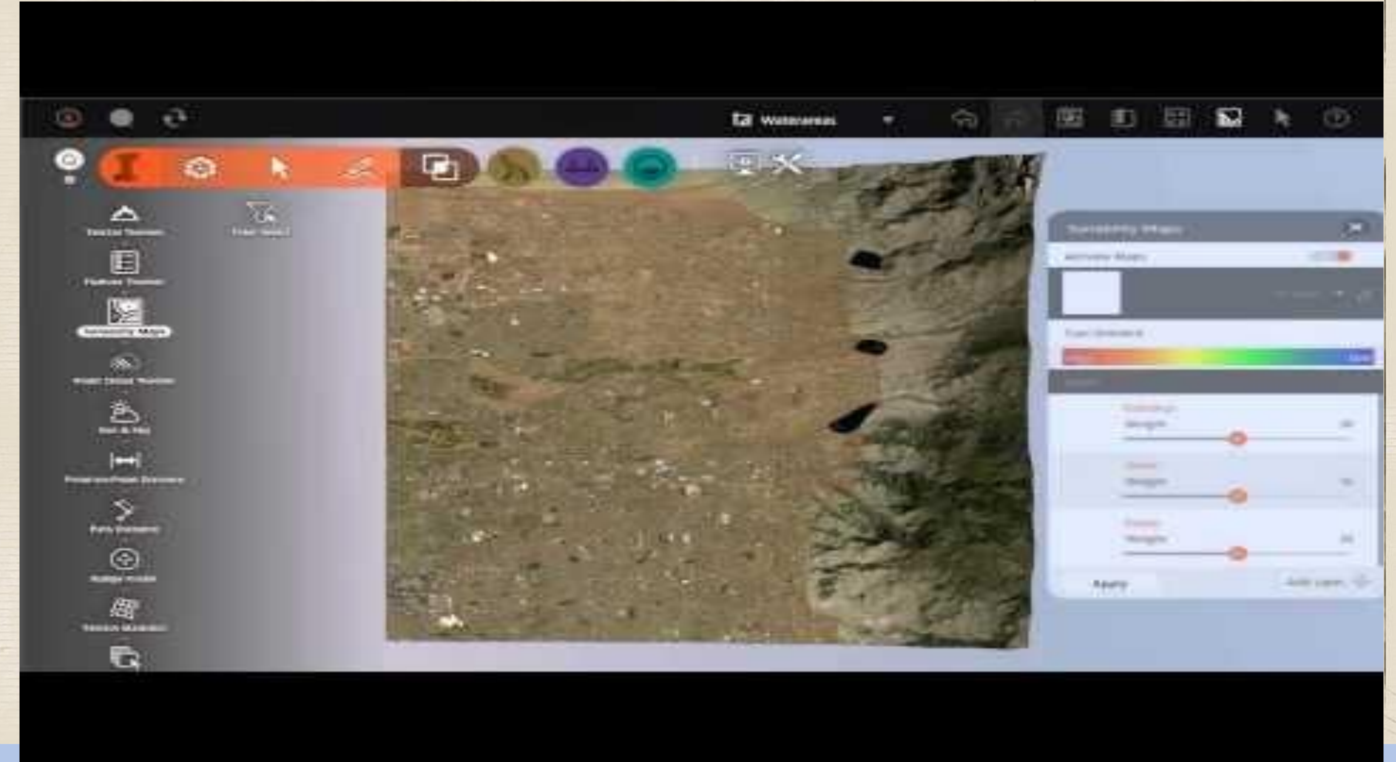


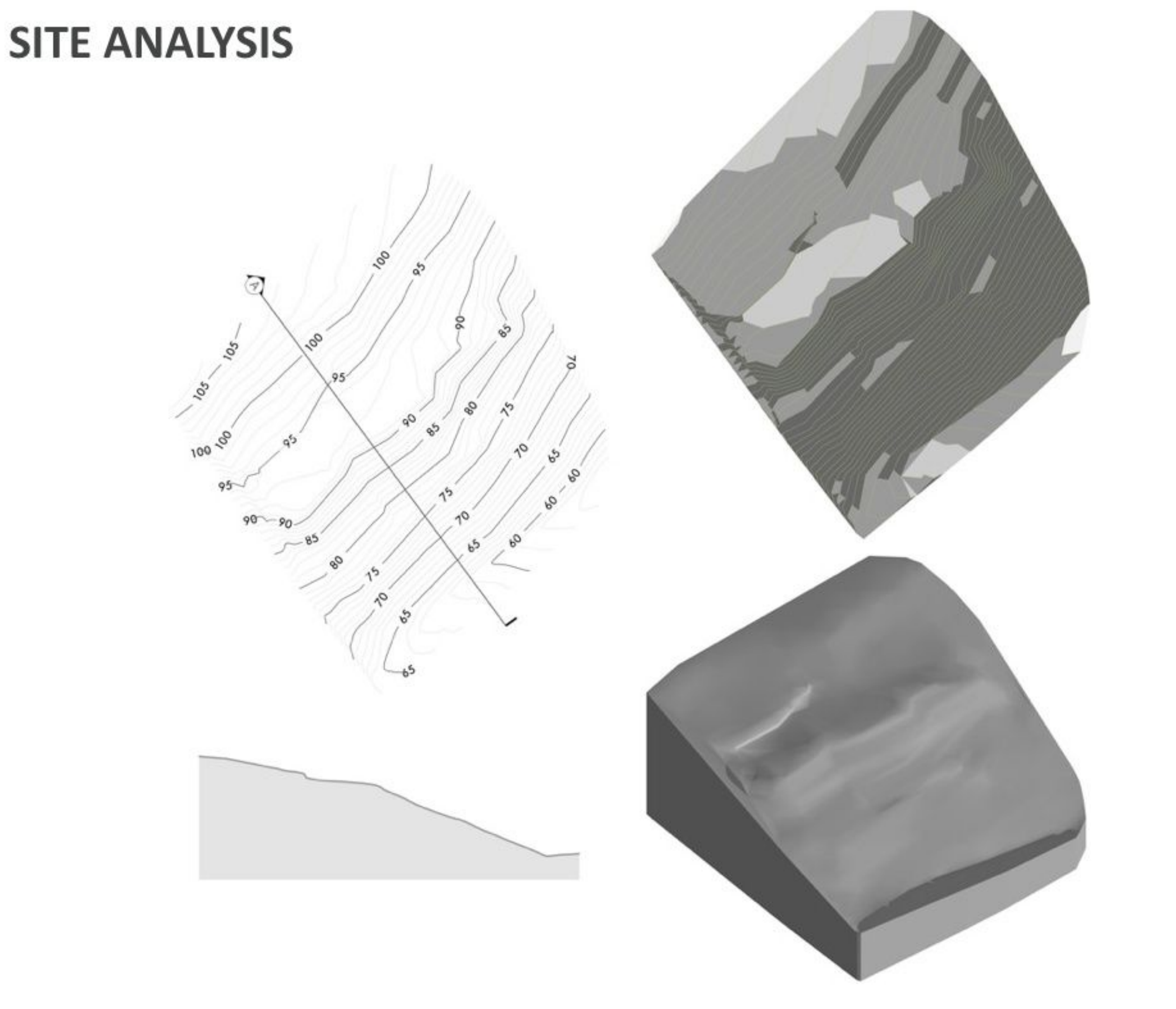


Suitability Maps for InfraWorks 360



Suitability Maps for InfraWorks 360

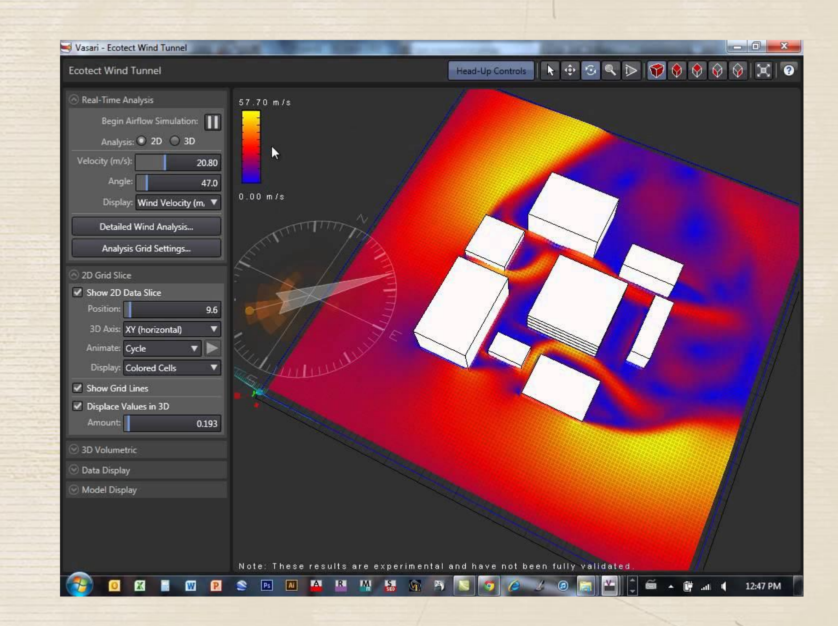



SITE ANALYSIS

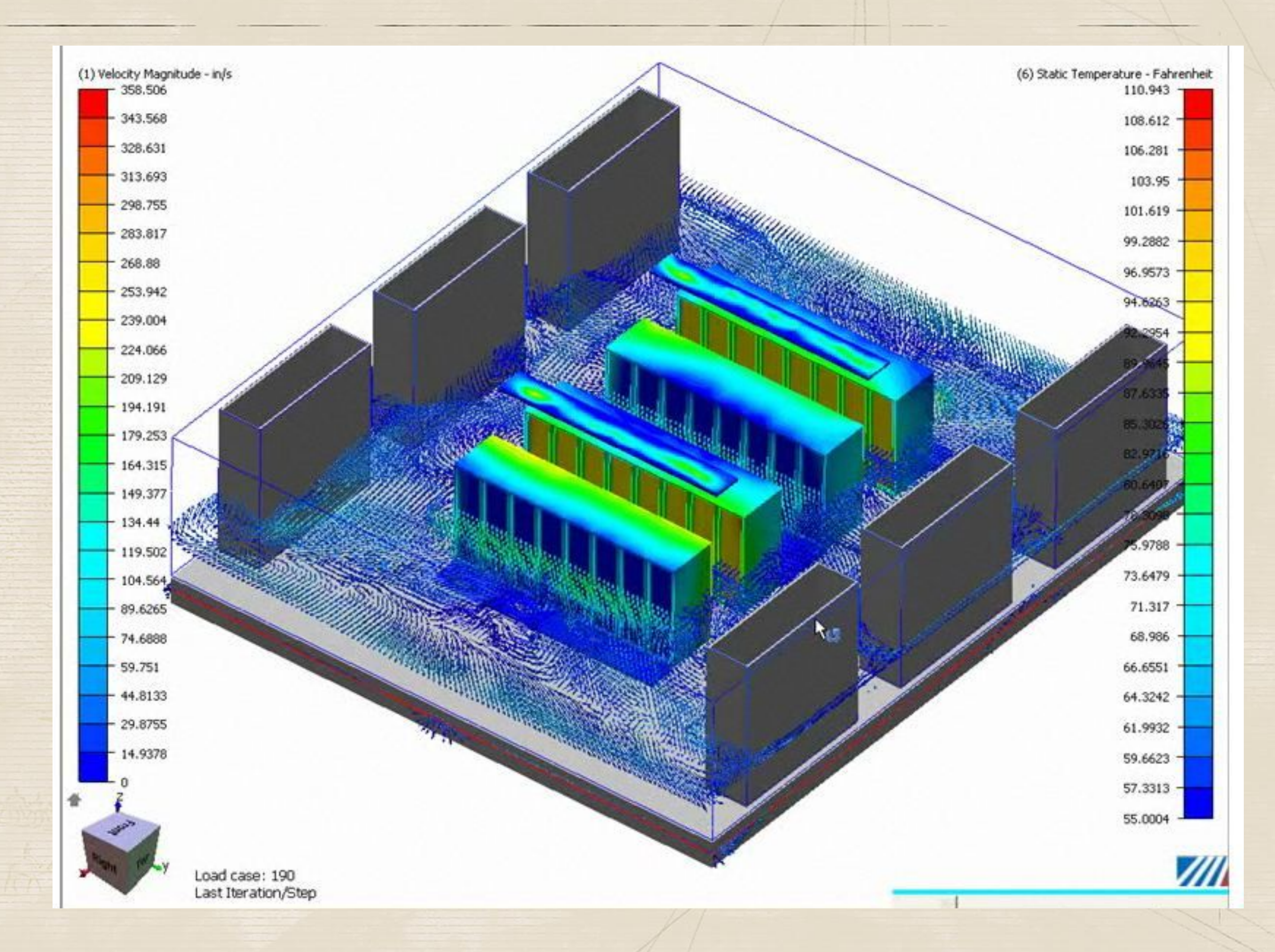
Applications: Autodesk Vasari

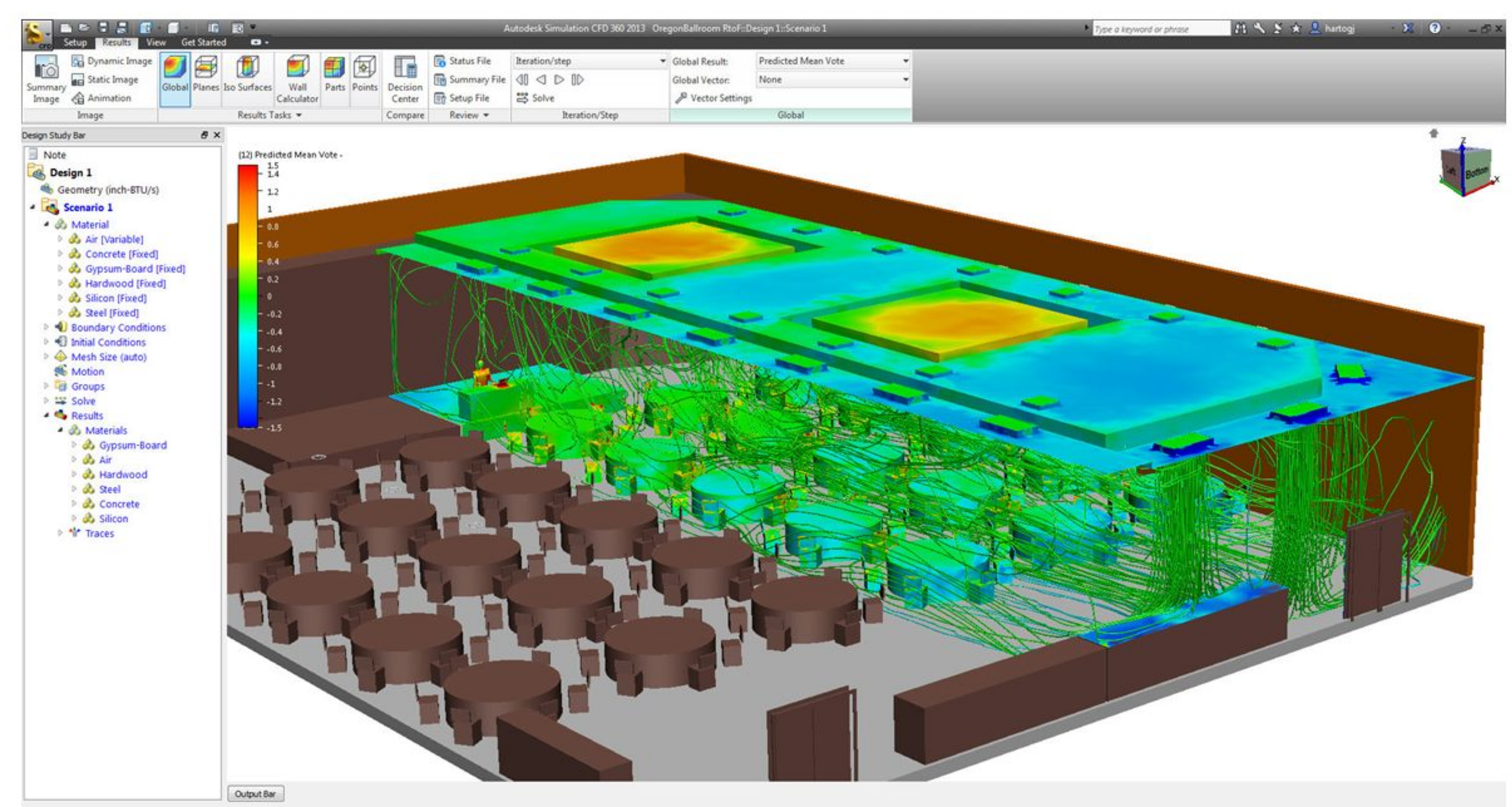
- conceptual building design (parametric massing) and provides energy/carbon analysis,solar radiation analysis, and more, you can create, analyze, and refine whole building models.

- Conceptual building models created with Vasari can also be used in Autodesk Revit to develop more detailed building models.

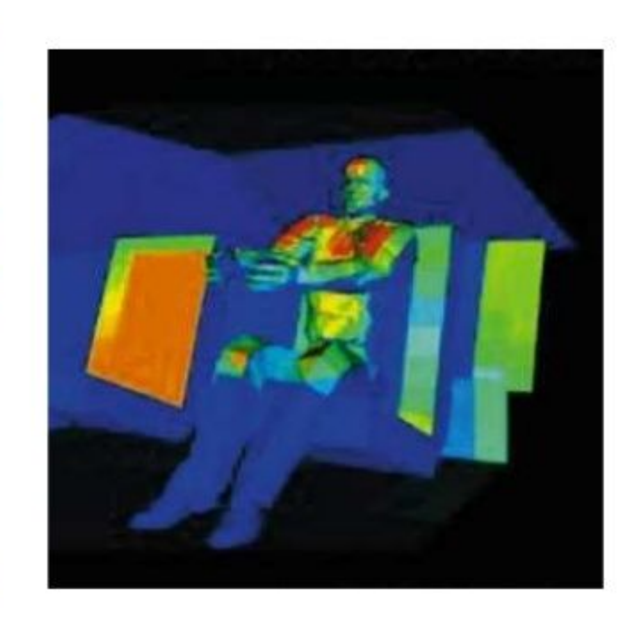


Autodesk CFD



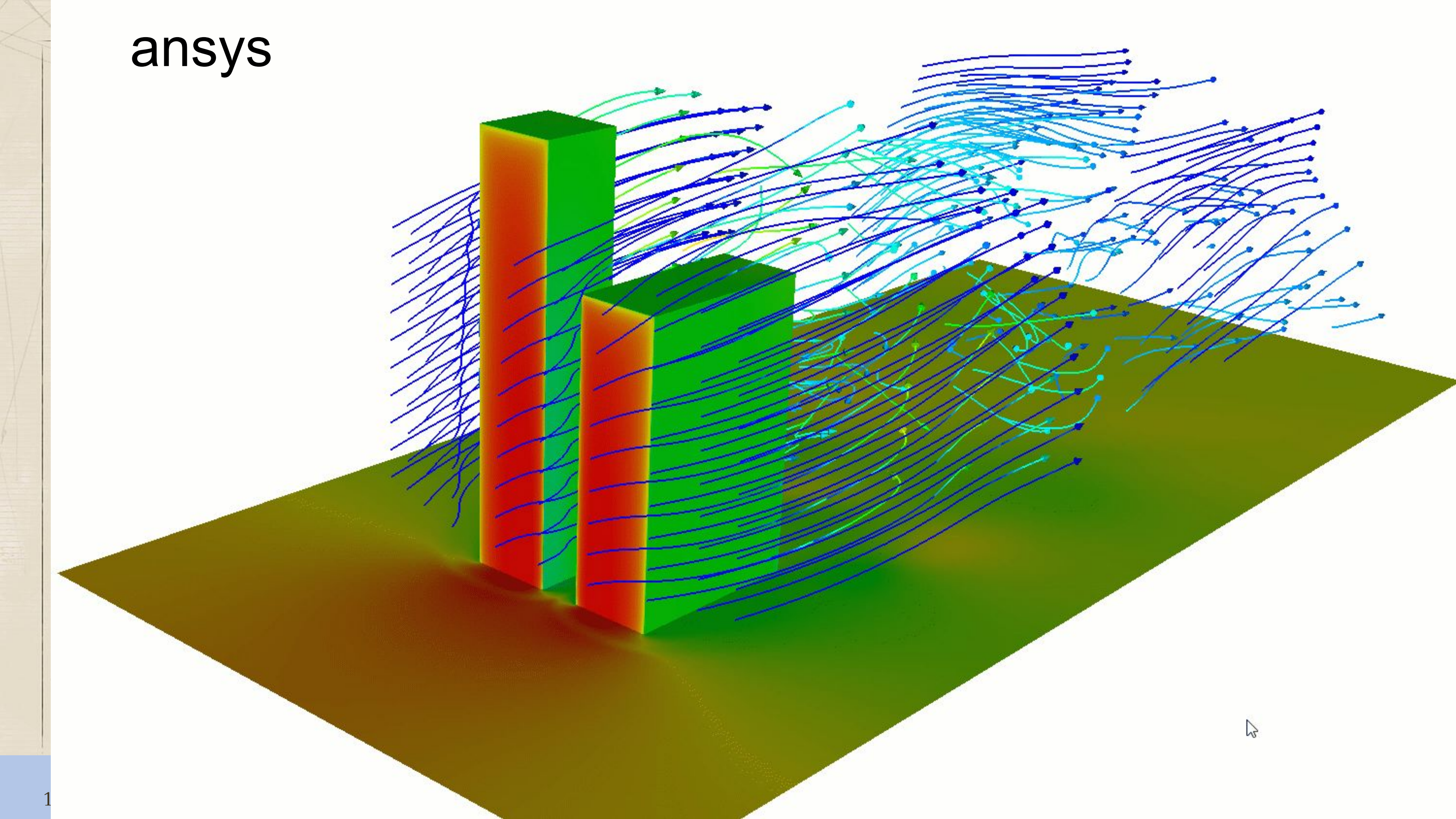

Autodesk Simulation CFD 360 2013 OregonBallroom RtoF::Design 1::Scenario 1
Type a keyword or phrase
hartogj
Setup
Results
View
Get Started
Summary Image
Dynamic Image
Static Image
Animation
Image
Global
Planes
Iso Surfaces
Wall Calculator
Parts
Points
Results Tasks
Decision Center
Compare
Status File
Summary File
Setup File
Review
Iteration/step
Solve
Iteration/Step
Global Result:
Predicted Mean Vote
Global Vector:
None
Vector Settings
Global
Design Study Bar
Note
Design 1
Geometry (inch-BTU/s)
Scenario 1
Material
Air [Variable]
Concrete [Fixed]
Gypsum-Board [Fixed]
Hardwood [Fixed]
Silicon [Fixed]
Steel [Fixed]
Boundary Conditions
Initial Conditions
Mesh Size (auto)
Motion
Groups
Solve
Results
Materials
Gypsum-Board
Air
Hardwood
Steel
Concrete
Silicon
Traces
(12) Predicted Mean Vote -
1.5
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.5
Output Bar

Computational Fluid Dynamics (CFD)

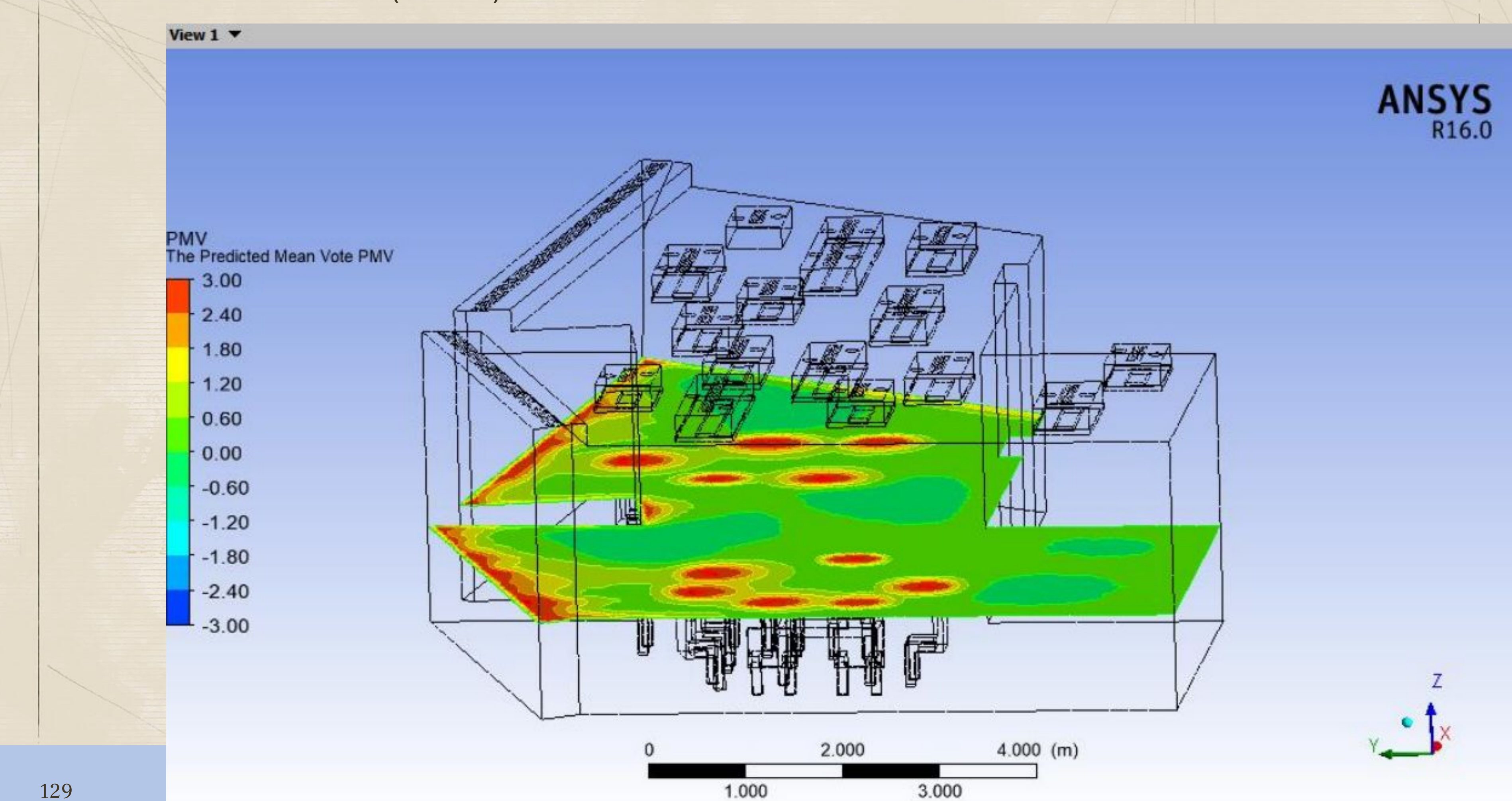


Automation simulation

Building Form Optimization for Natural Ventilation with Using CFD simulation, ISOENV with MODU Architecture NY, 2014


ansys

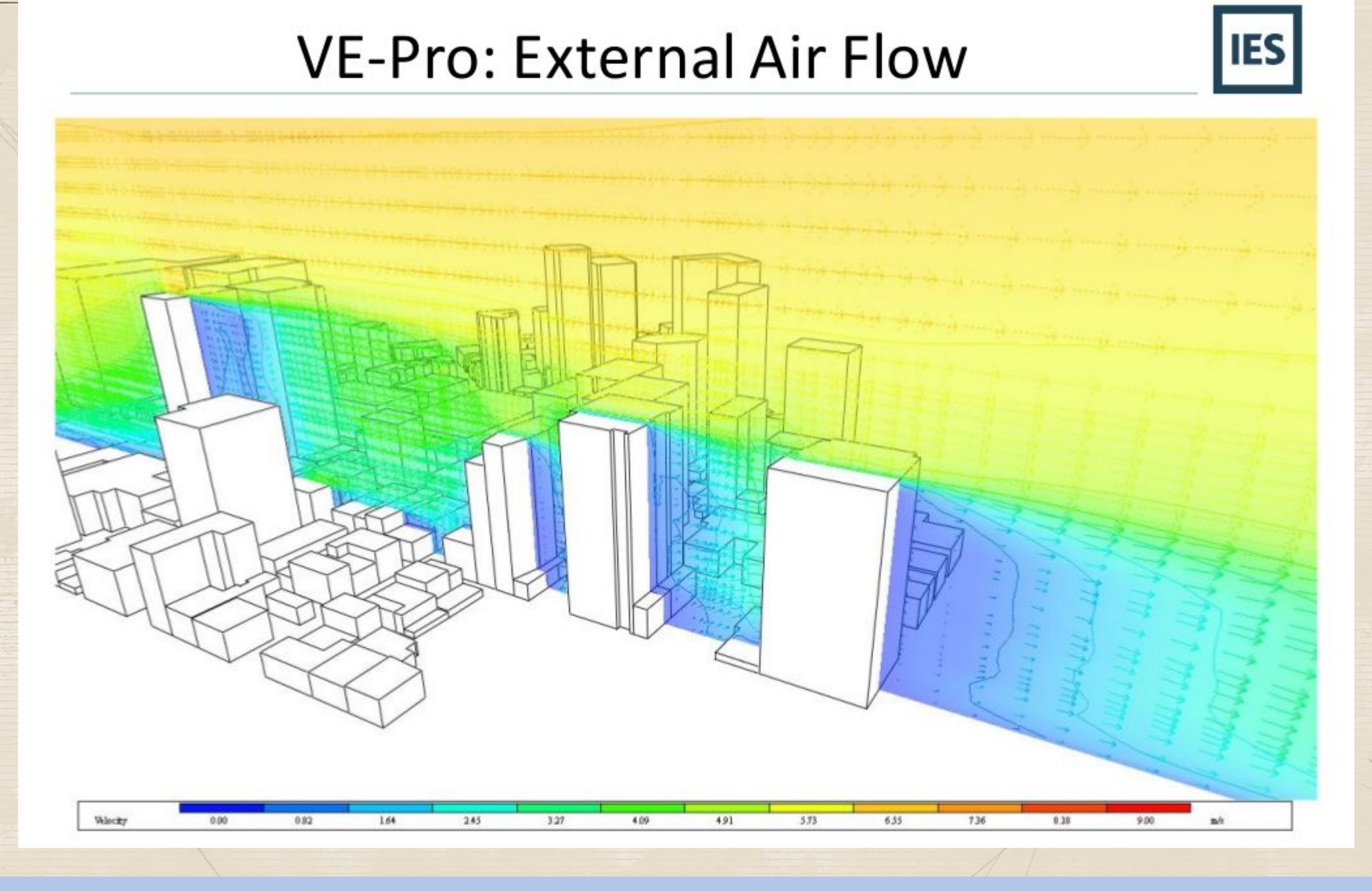
National Museum of Qatar (NMoQ)



Energy Analysis



District buildings modelled in more detail


VE-Pro: External Air Flow
IES
Velocity
0.00
0.82
1.64
2.45
3.27
4.09
4.91
5.73
6.55
7.36
8.18
9.00
m/s

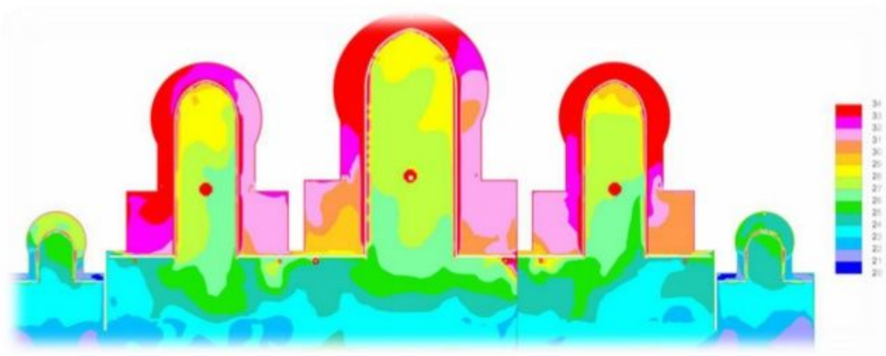
IES

Sheik Zayad Mosque, Abu Dhabi, UAE





IES were appointed to conduct thermal simulation analysis of the mosque using their building analysis software to determine internal thermal comfort conditions, optimise HVAC system performance and verify building safety.



Solar Shadow Study

IES



Tracking Internal Solar Radiation



Surface Solar Radiation: Winter Day



Surface Solar Radiation: 15 January (Red High, Blue Low)

Surface Solar Radiation: Summer Day



Surface Solar Radiation: 23 June (Red High, Blue Low)

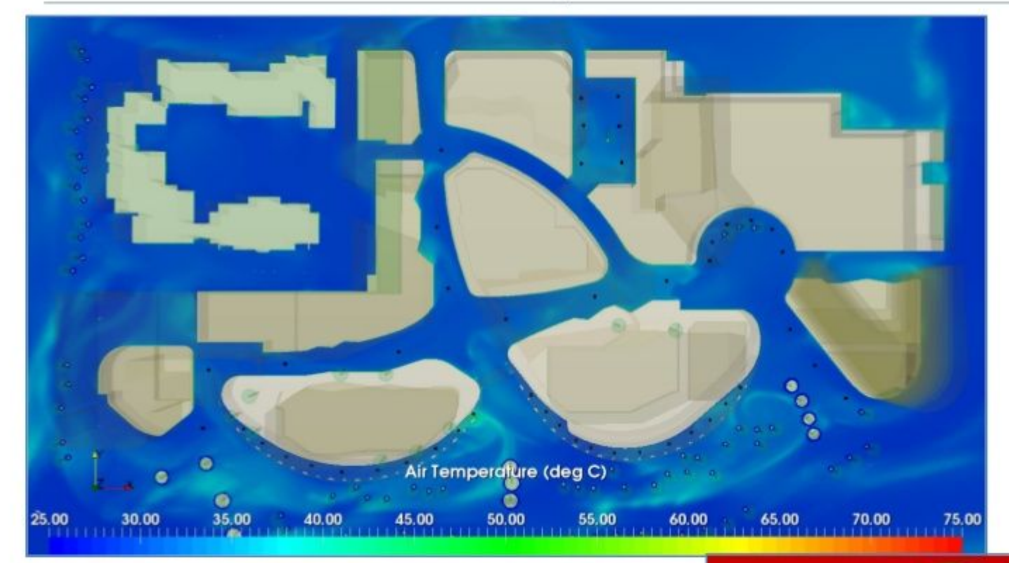
Athaiba Development, Muscat Oman

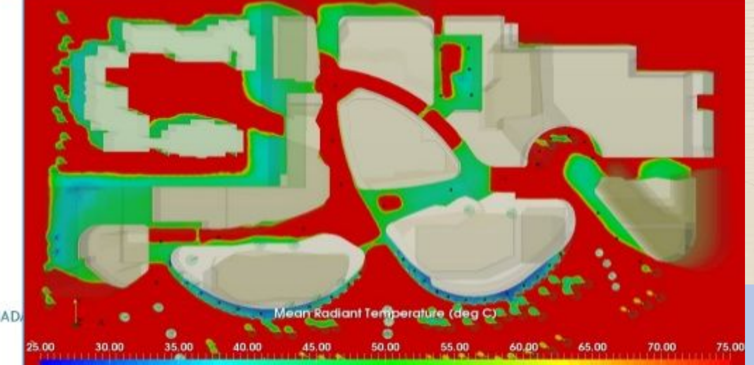


www.iesve.com UNITED KINGDOM | IRELAND | UNITED

Athaiba Development, Muscat Oman

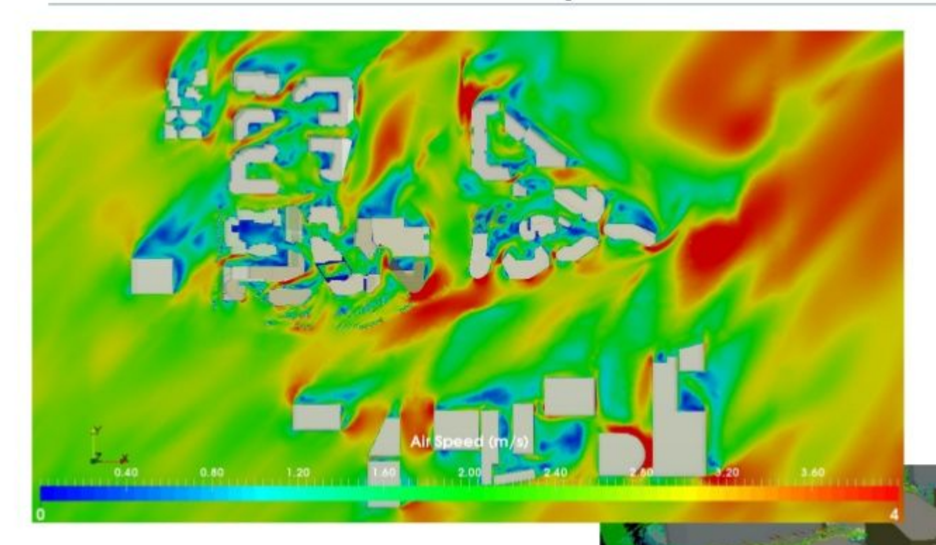






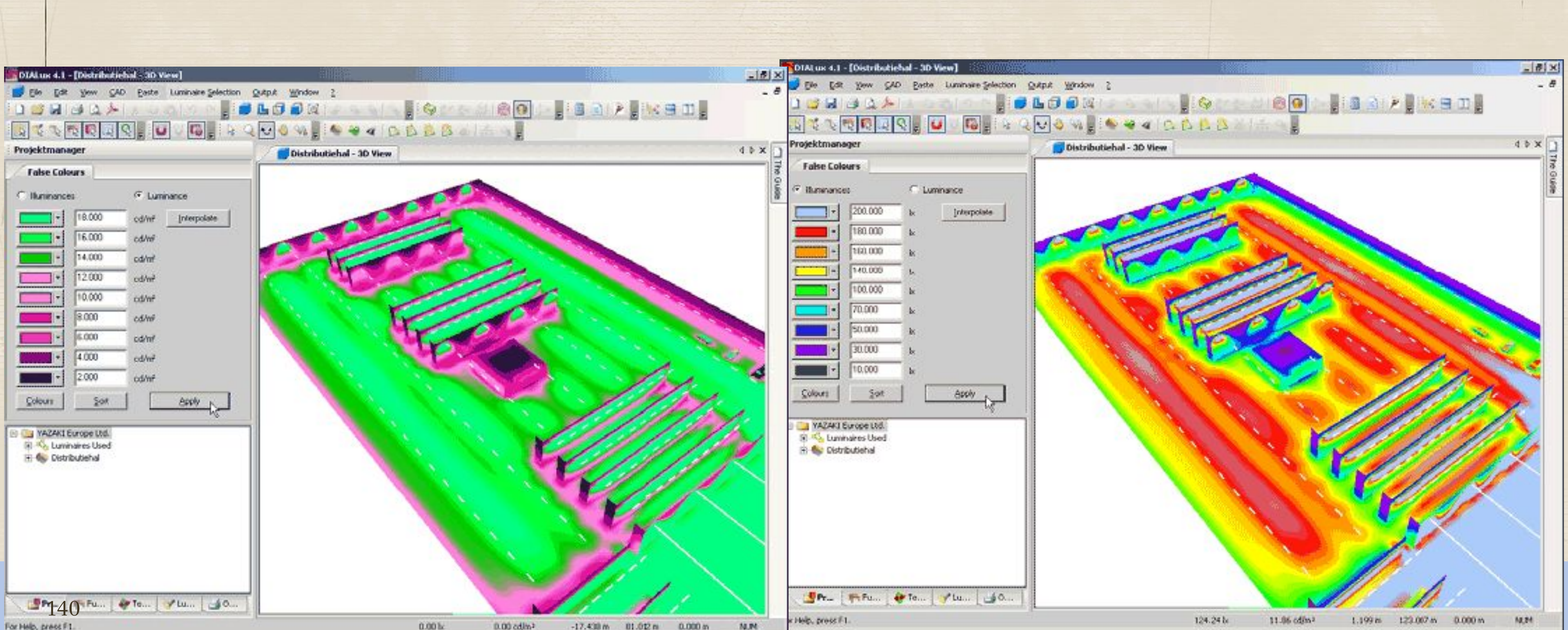
Athaiba Development, Muscat Oman



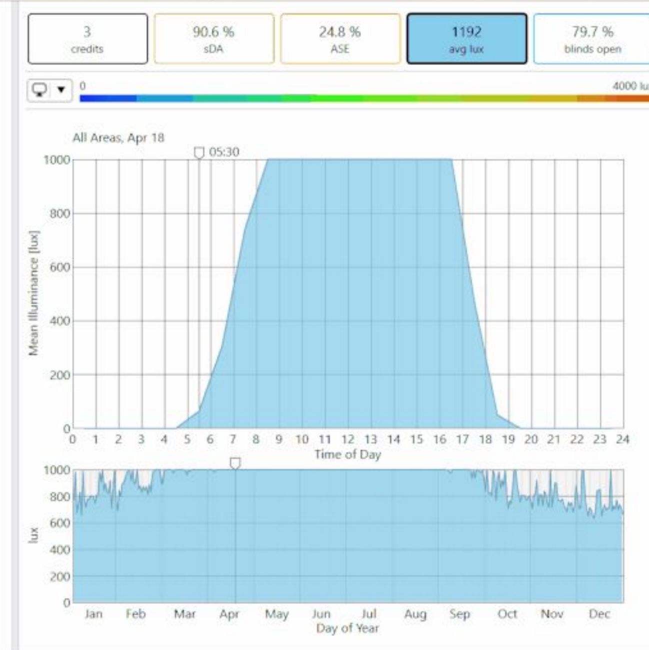




Dialux


DIALux 4.1 - [Distributiehal - 3D View]
Projektmanager
Distributiehal - 3D View
False Colours
Illuminances
Luminance
Interpolate
18.000
16.000
14.000
12.000
10.000
8.000
6.000
4.000
2.000
cd/m²
Colours
Sort
Apply
YAZAKI Europe Ltd.
Luminaires Used
Distributiehal
DIALux 4.1 - [Distributiehal - 3D View]
Projektmanager
Distributiehal - 3D View
False Colours
Illuminances
Luminance
Interpolate
200.000
180.000
160.000
140.000
100.000
70.000
50.000
30.000
10.000
lx
Colours
Sort
Apply
YAZAKI Europe Ltd.
Luminaires Used
Distributiehal

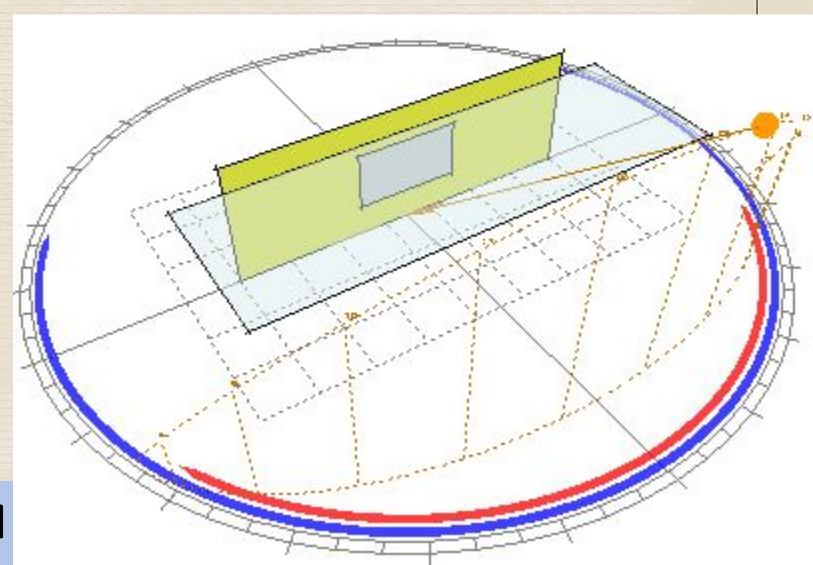
CLIMATESTUDIO



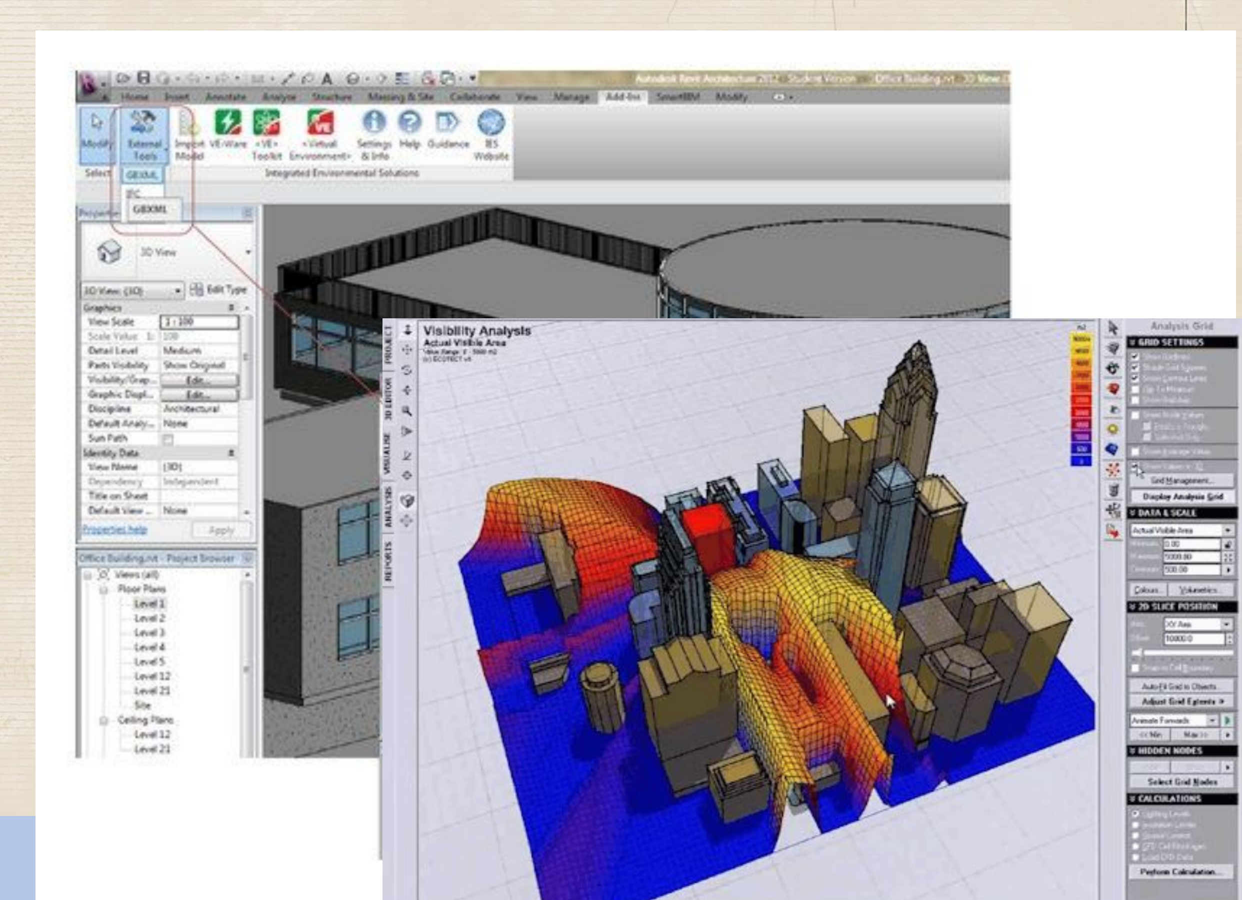
Applications: ECOTECT



- Fully integrated building & HVAC program for architects, engineers, and researchers
- Stand-alone engine without a graphical interface
- Reads input and writes output as text files
- Simulates
  building heating,
  cooling,
  lighting,
  ventilating,
  and other energy flows
- Results
  Load Calculations
  Energy Analysis
  Indirect environmental effects

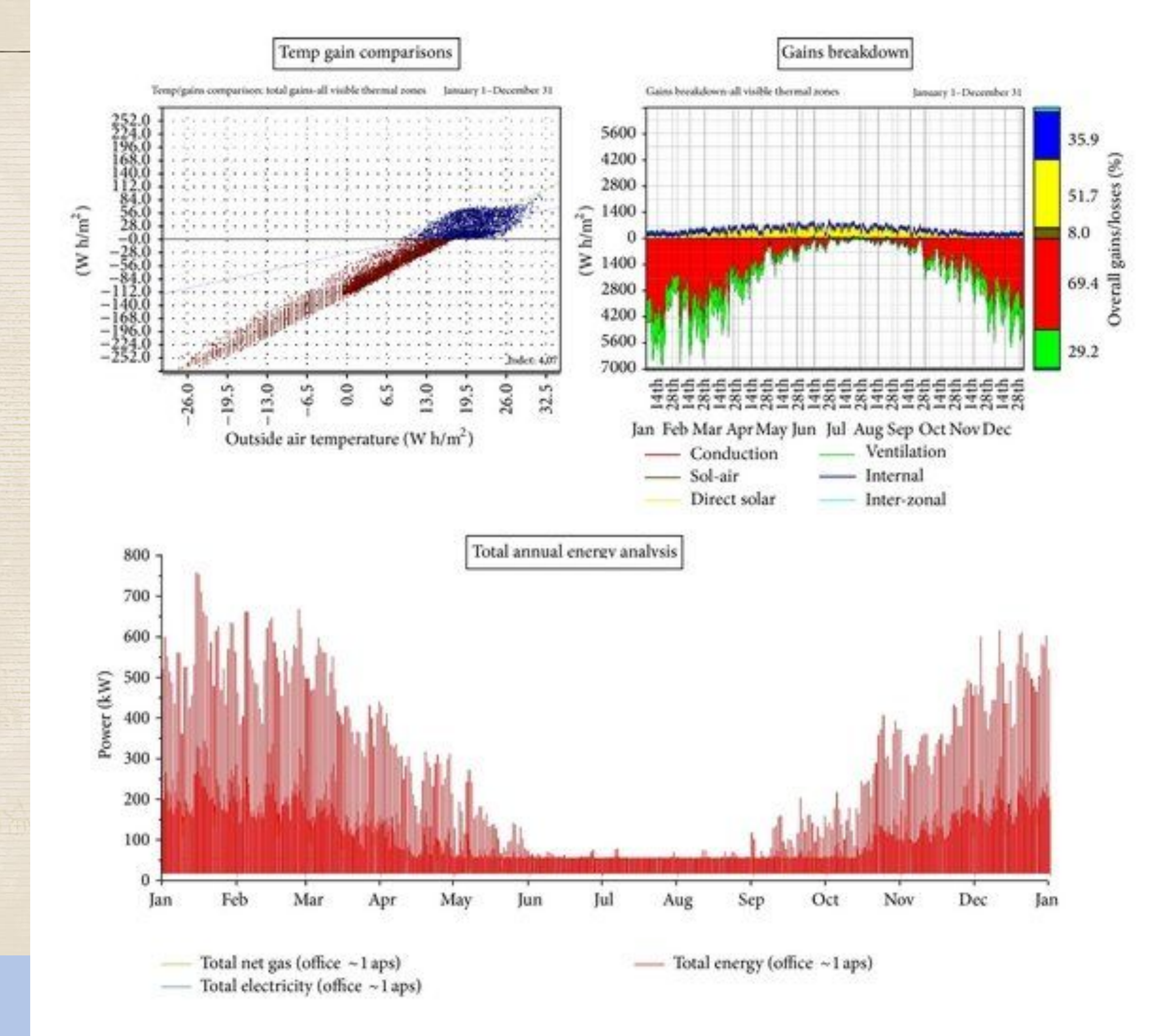


directly transferring BIM model to Ecotect via plug-in based on gbXML file format.



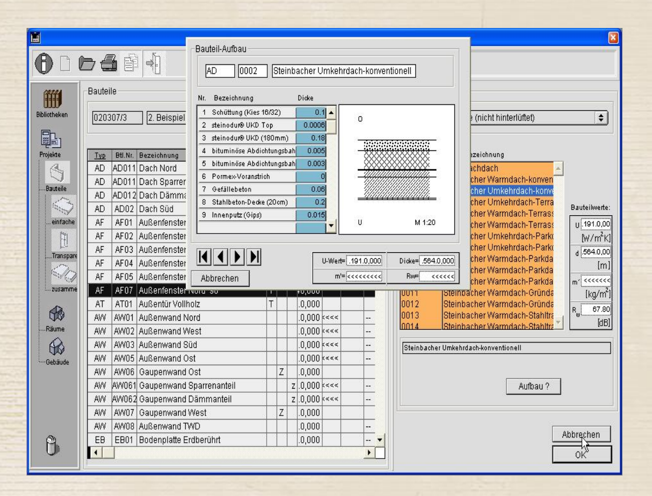
Software

sample thermal energy analysis in Ecotect.



Applications: ArchiPHYSIK

- A complete solution for thermal analysis including U-value, vapor diffusion and temperature amplitudes.
- Identifies failures compared to pre-defined values.
- Building performance
- Building component performance

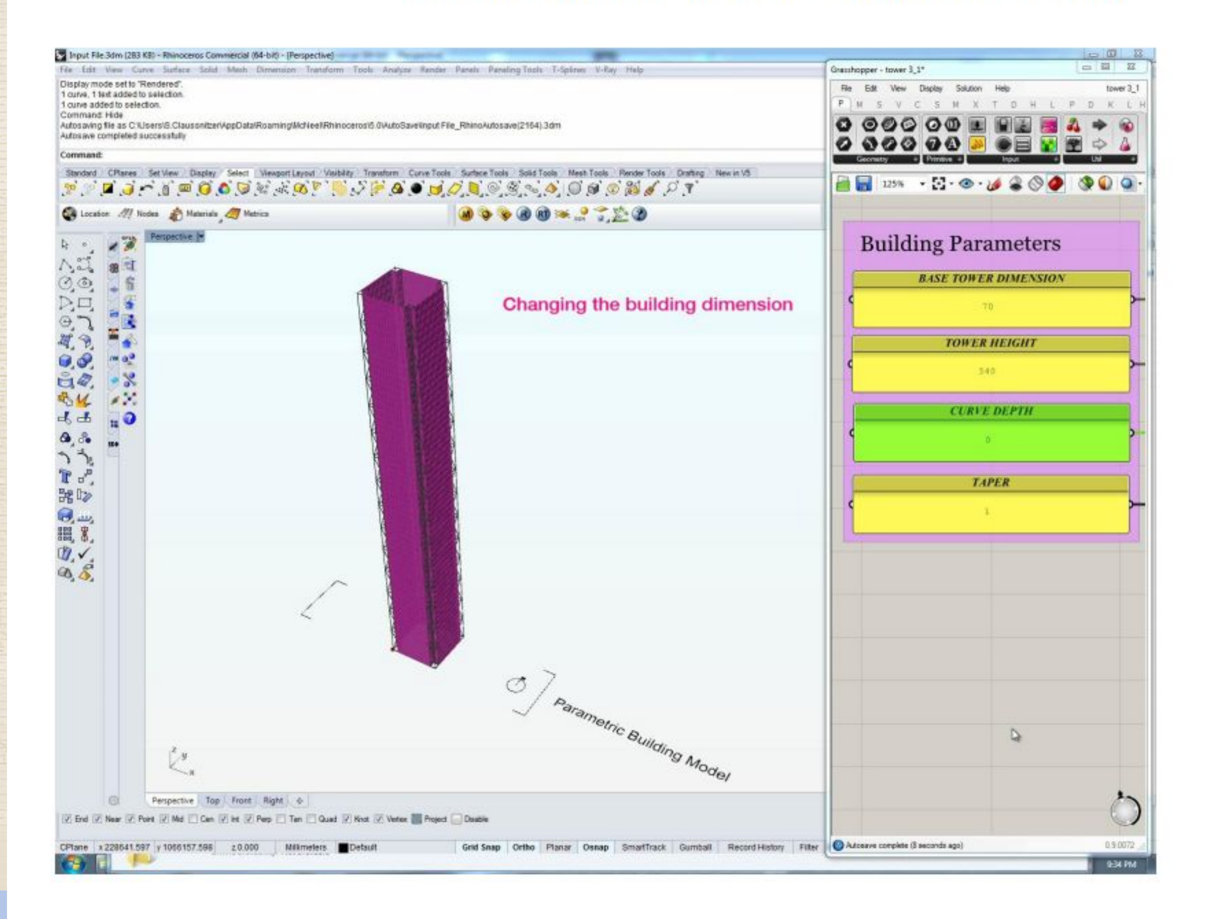


Software

Rhino
Grasshopper

INTEGRATED DATA MODEL

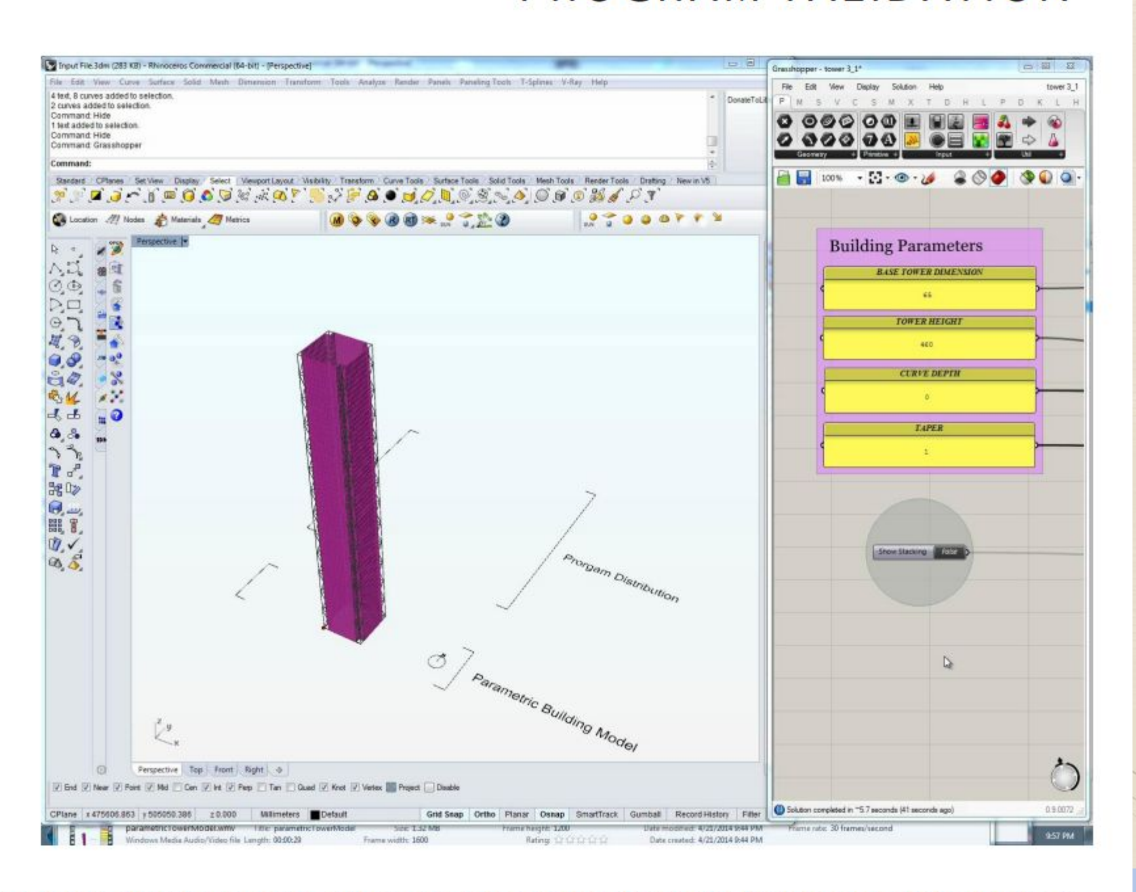
INTEGRATED DESIGN INTENT



PARAMETRIC BUILDING MODEL WITH ENCODED DESIGN INTENT

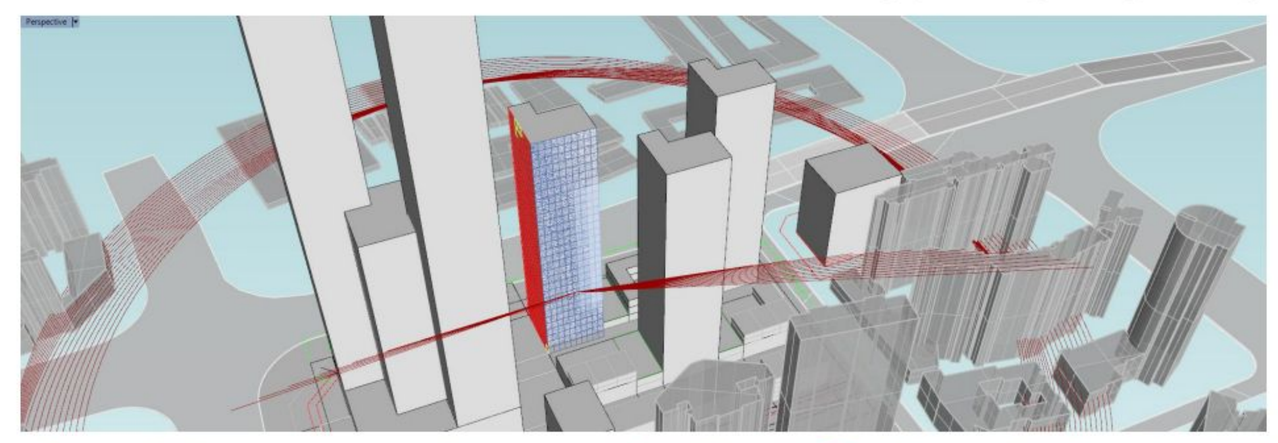
INTEGRATED DATA MODEL

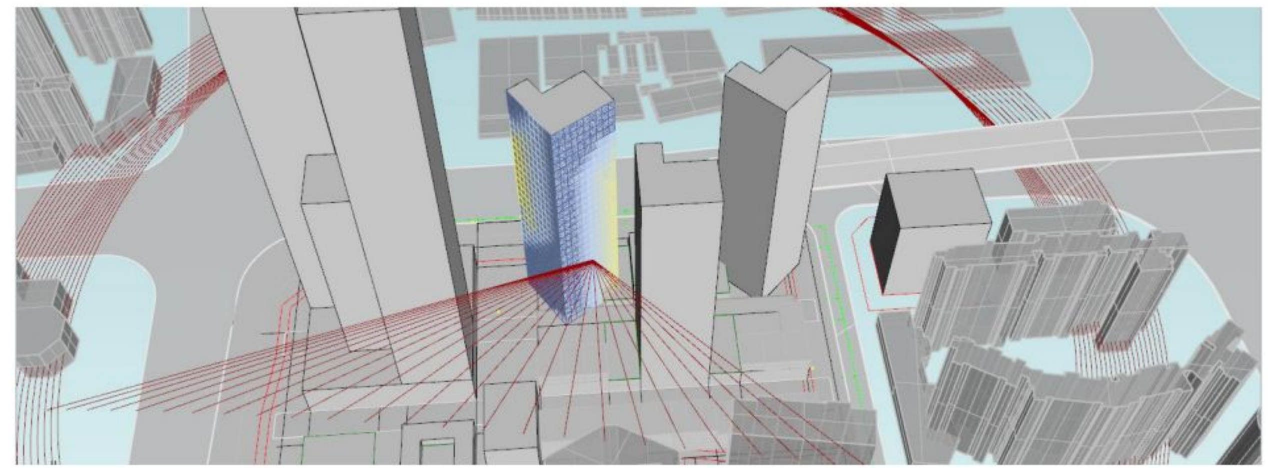
PROGRAM VALIDATION



PARAMETRIC BUILDING MODEL UNDERSTANDS PLANING CONSTRAINTS

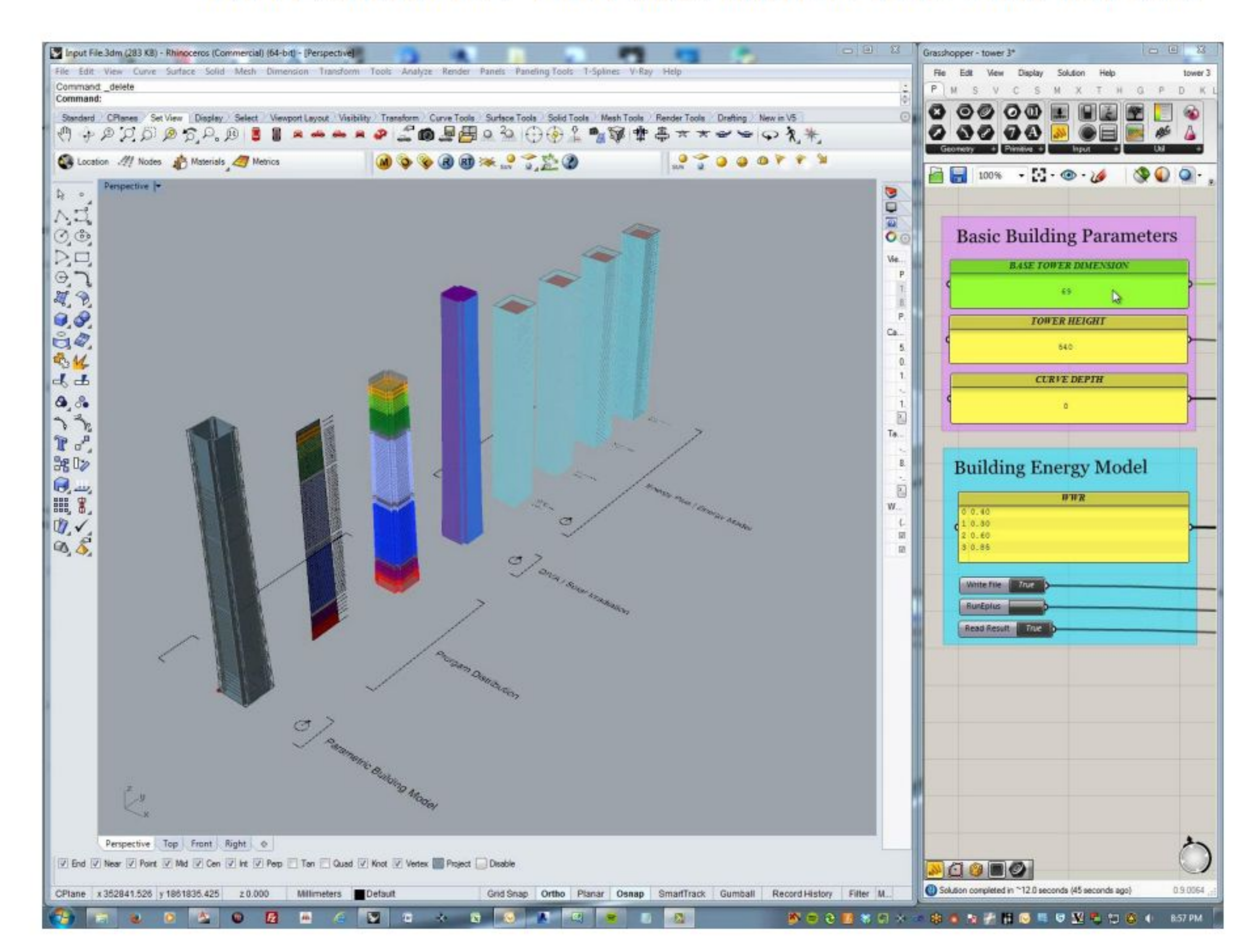
INTEGRATED DATA MODEL
CODE CHECKING





INTEGRATED DATA MODEL

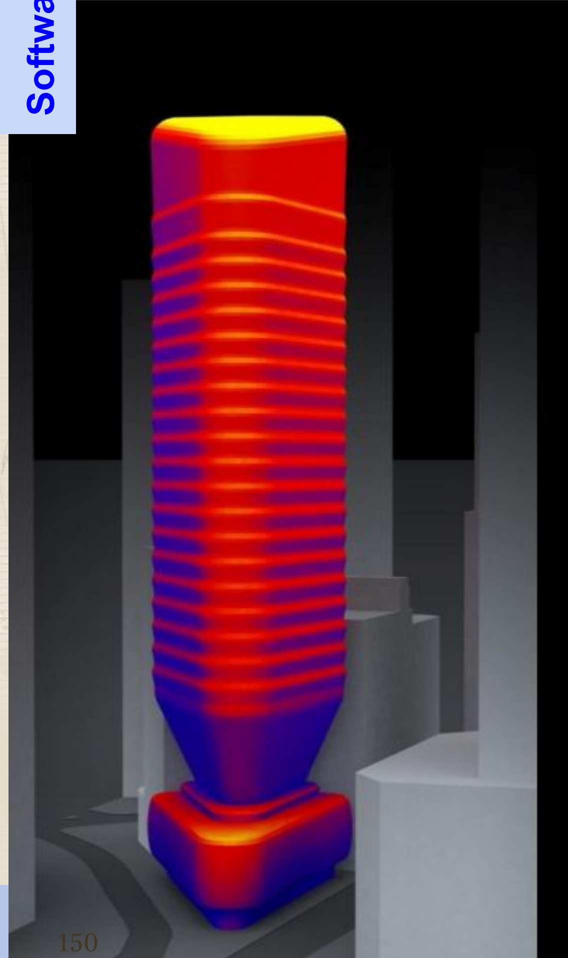
INTEGRATED ENVIRONMENTAL ANALYSIS

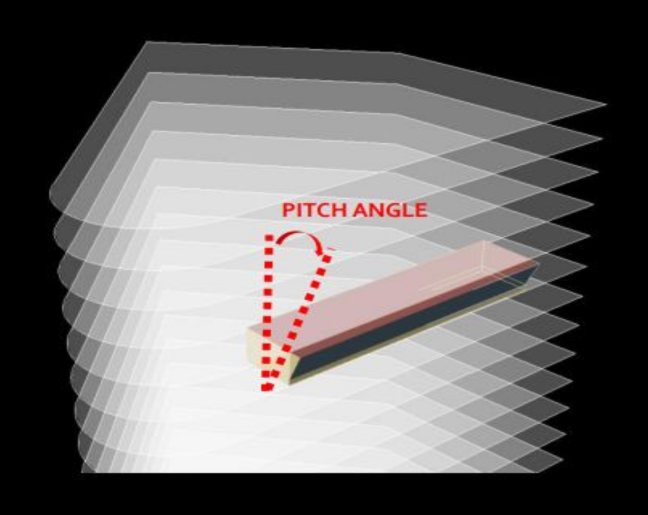


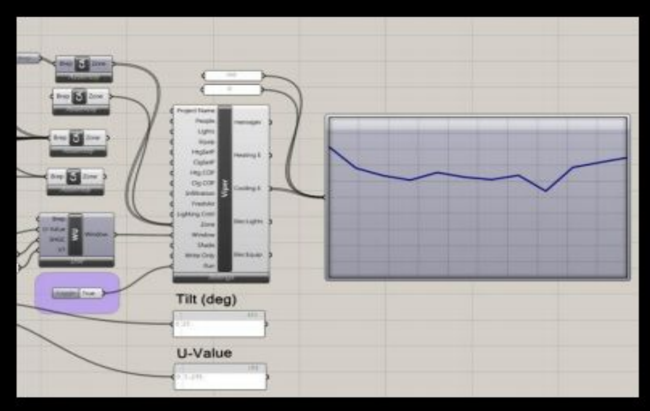
Software

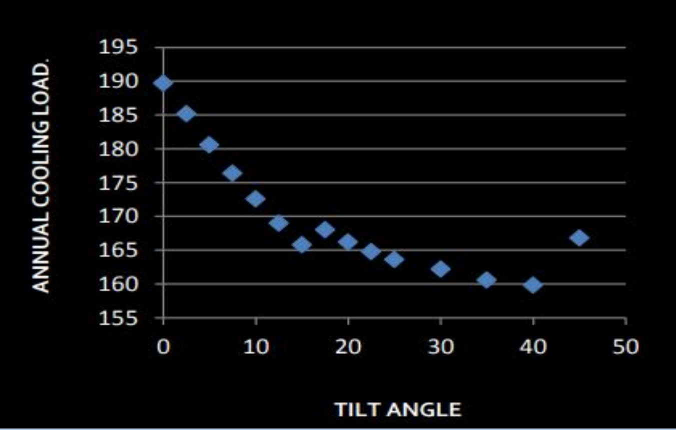
INTEGRATED DATA MODEL

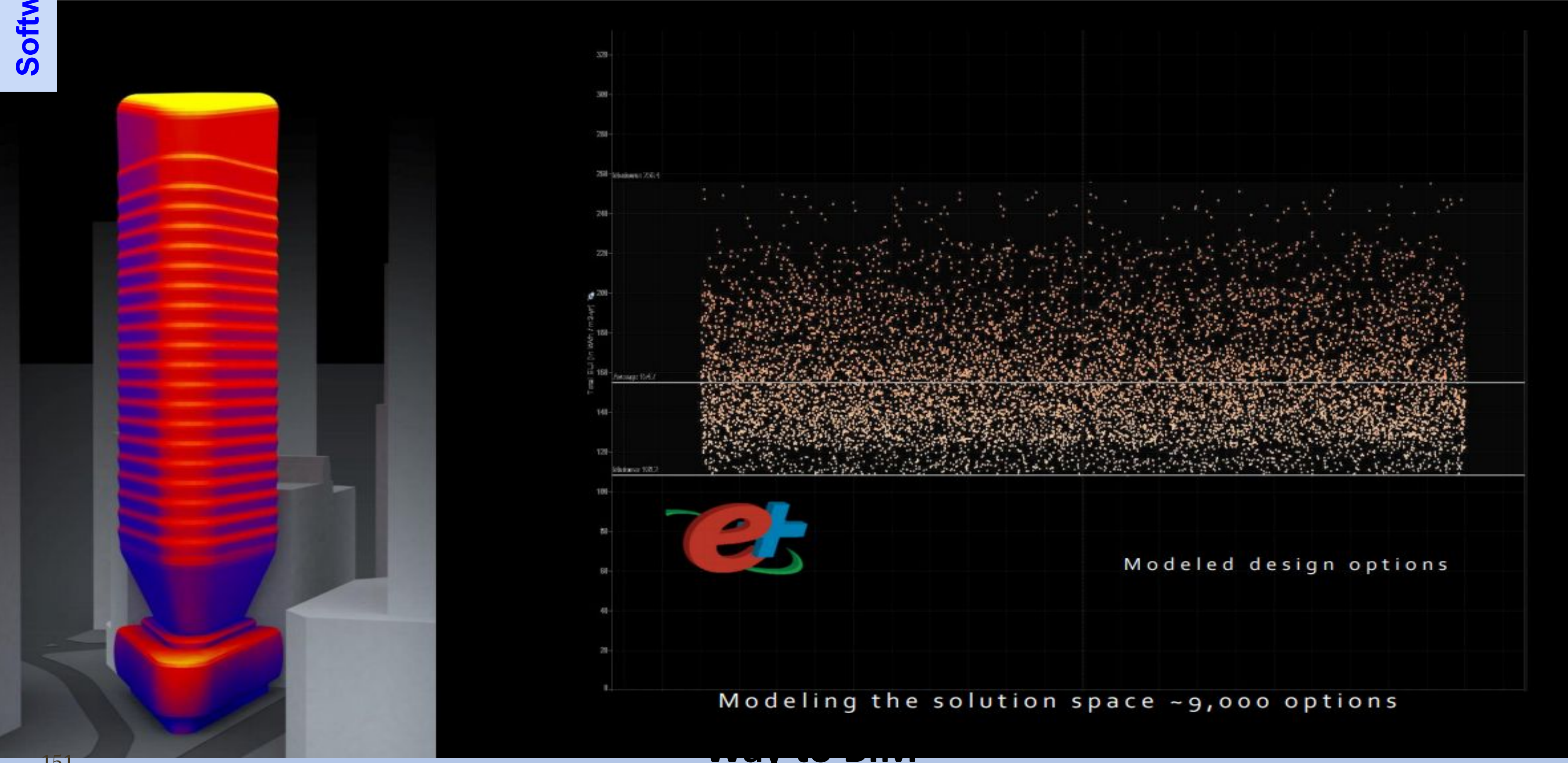
PARAMETRIC ENERGY ANALYSIS





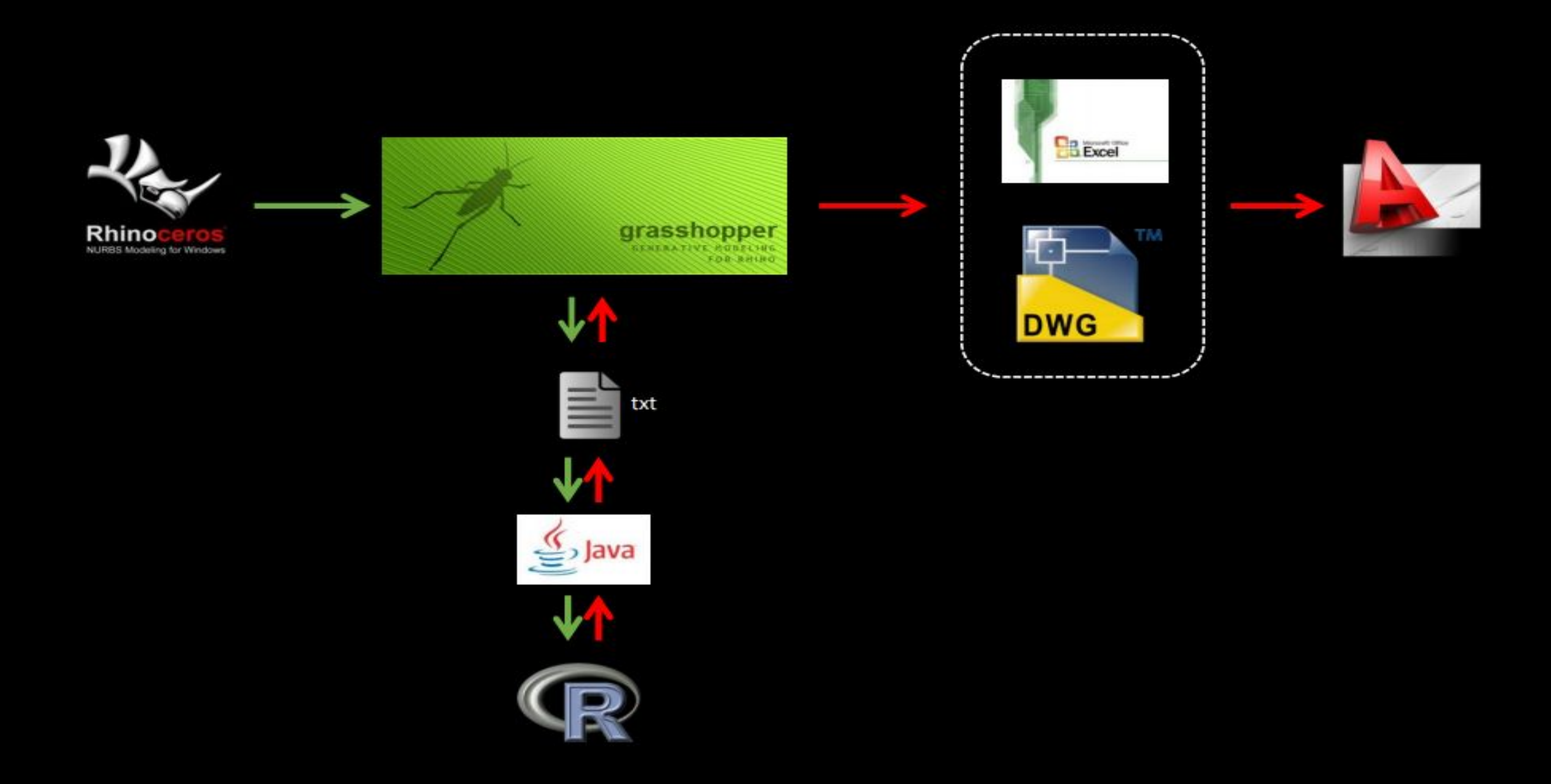





Software
INTEGRATED DATA MODEL
PARAMETRIC ENERGY ANALYSIS
Modeled design options
Modeling the solution space ~9,000 options

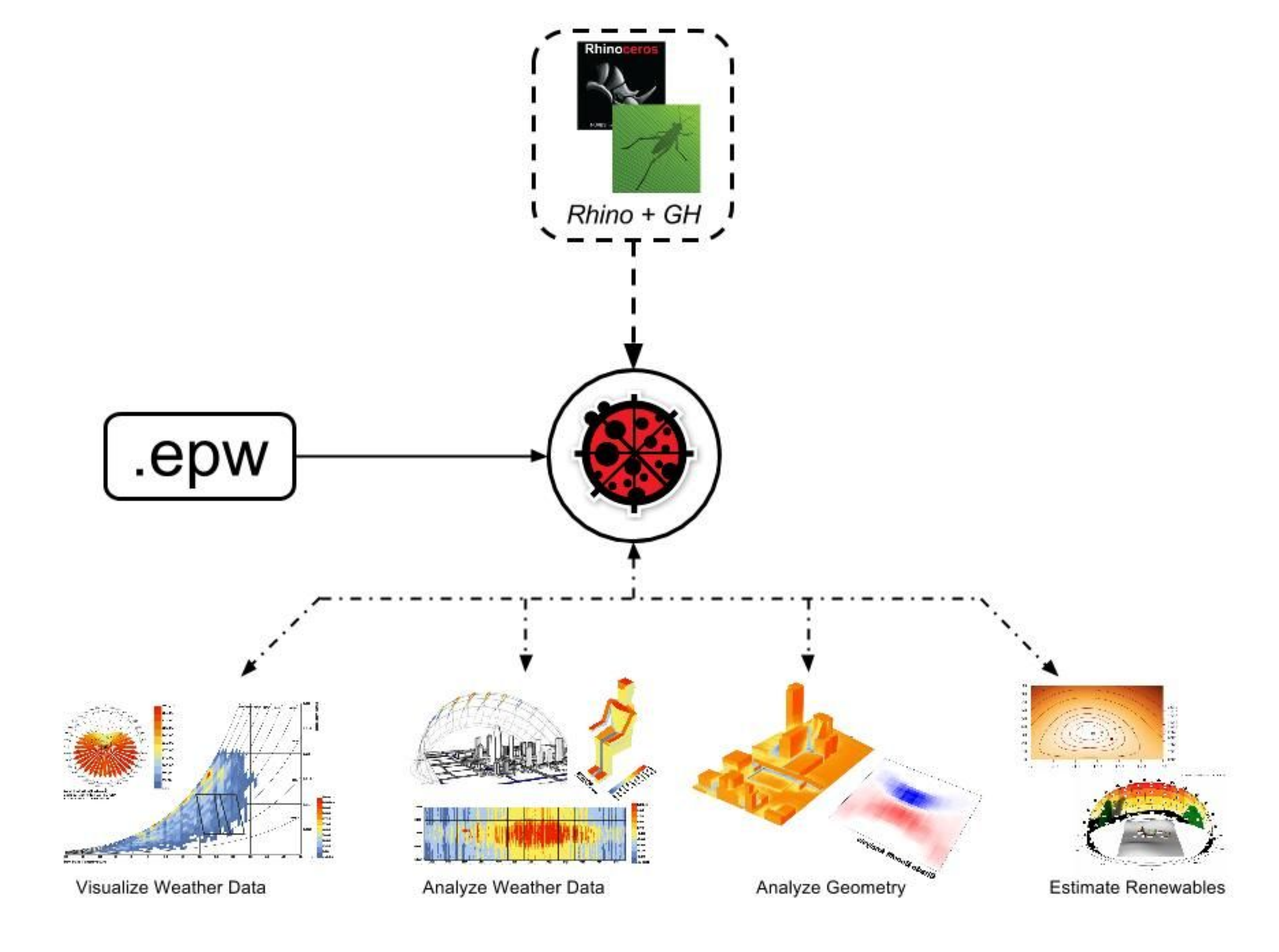
INTEGRATED DATA MODEL

DATA INTER-PLATFORM COLLABORATION



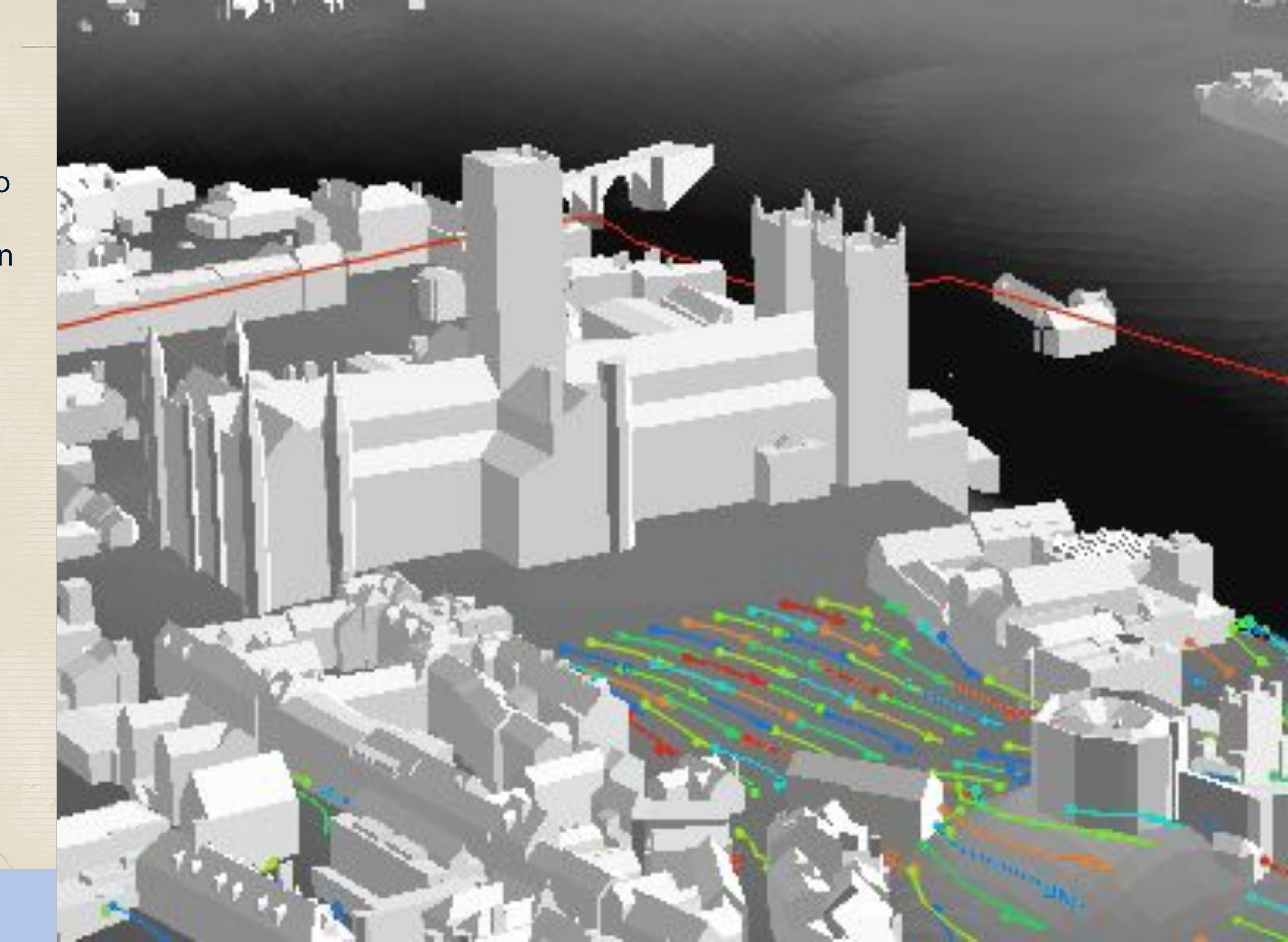
ladybug

Ladybug allows you to import and analyze standard weather data in Grasshopper; draw diagrams like Sun-path, wind-rose, radiation-rose, etc; customize the diagrams in several ways; run radiation analysis, shadow studies, and view analysis.



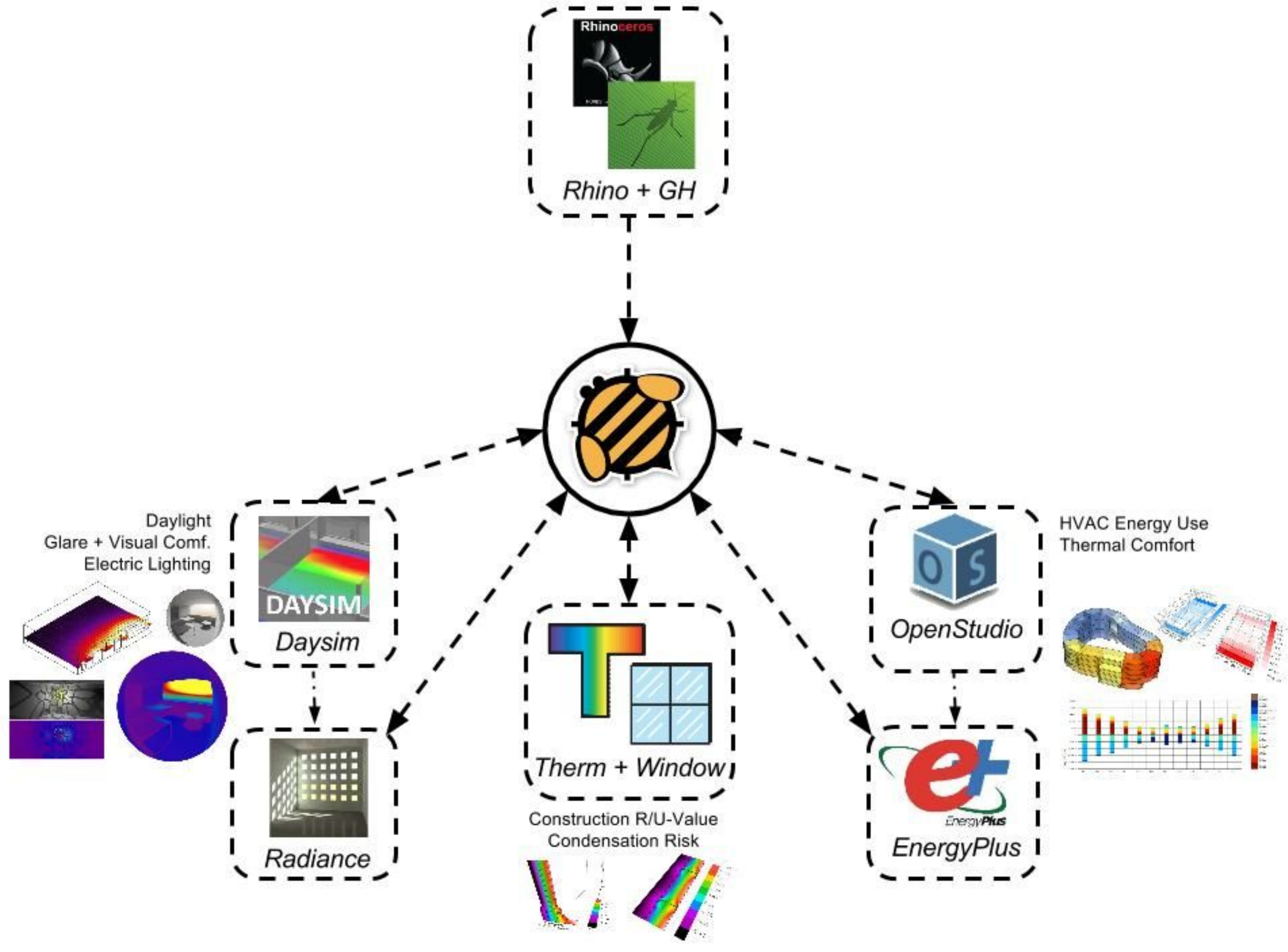
Butterfly

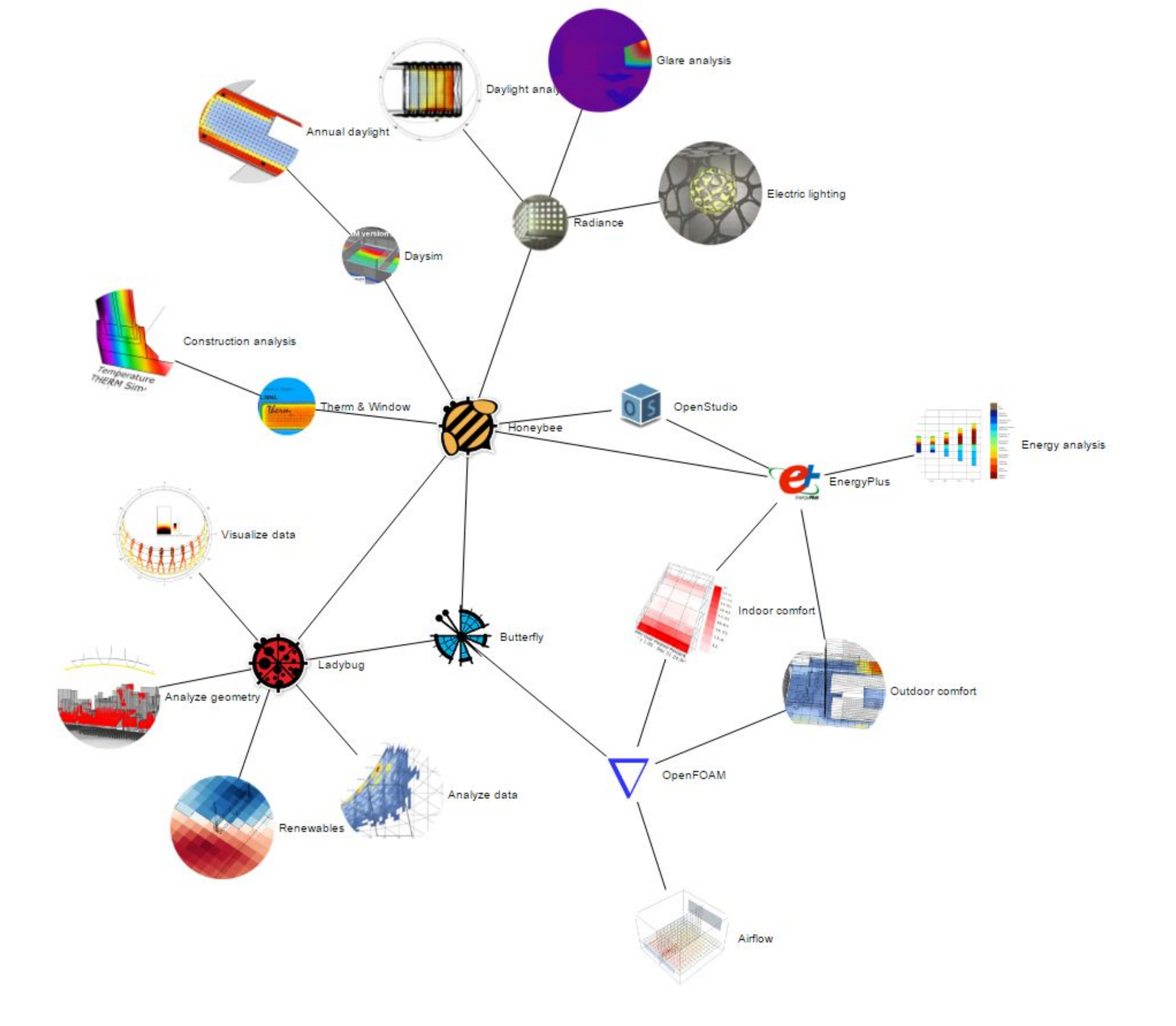
Butterfly is a Grasshopper/Dynamo plugin and object-oriented python library that creates and runs computational fluid dynamics (CFD) simulations using OpenFOAM.



Honeybee

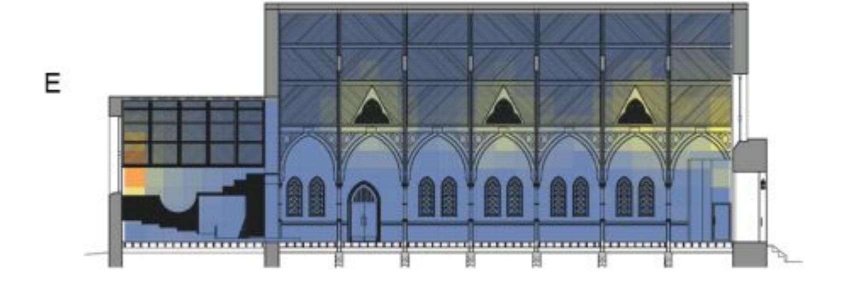
Honeybee connects Grasshopper3D to validated simulation engines such as EnergyPlus, Radiance, Daysim and OpenStudio for building energy, comfort, daylighting and lighting simulation.

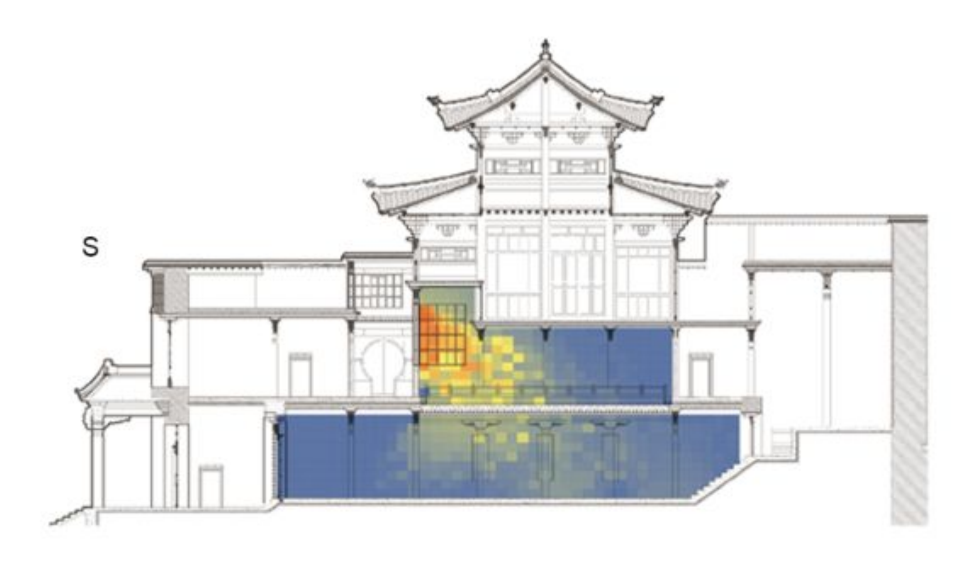



Glare analysis
Daylight analy
Annual daylight
Electric lighting
Radiance
Daysim
Construction analysis
Therm & Window
Honeybee
OpenStudio
Energy analysis
EnergyPlus
Visualize data
Indoor comfort
Butterfly
Ladybug
Outdoor comfort
Analyze geometry
OpenFOAM
Analyze data
Renewables
Airflow

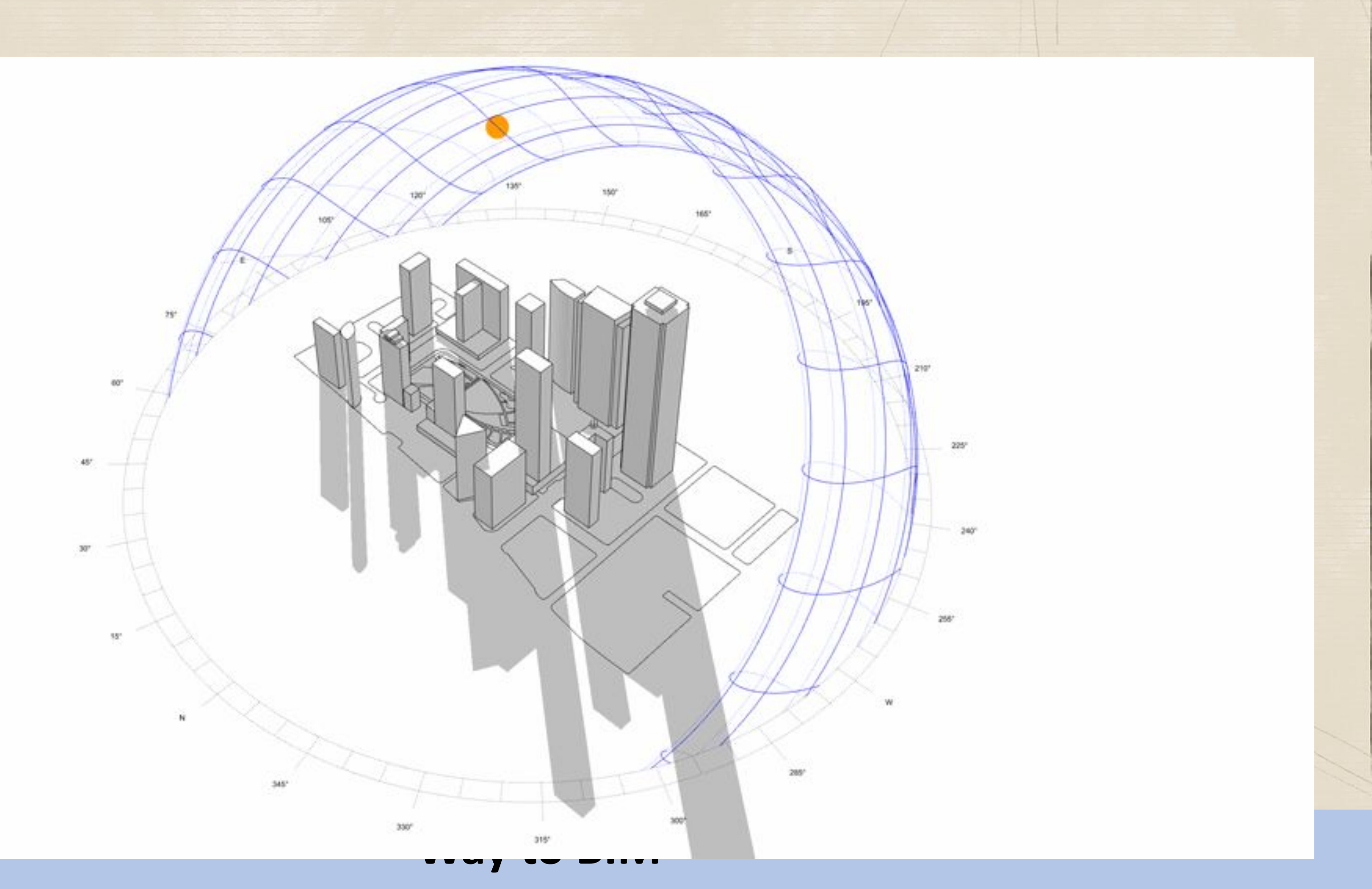
DIVA-for-Rhino

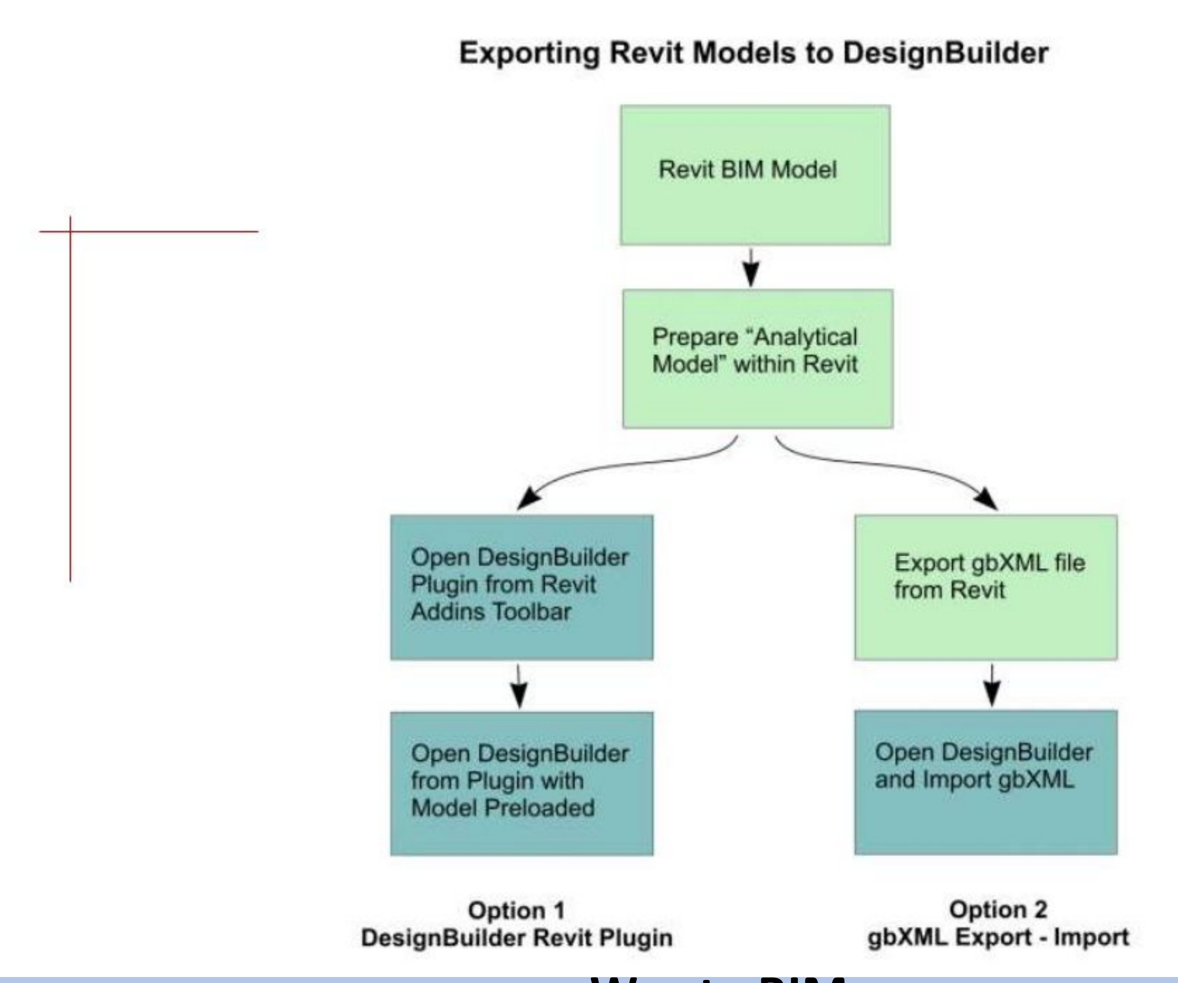
- Point in Time Visualization
- Daylight Factor
- Illuminance Distribution
- LEED Compliance
- Radiation Maps
- Spatial Daylight Autonomy
- Annual Solar Exposure





DIVA-for-Rhino

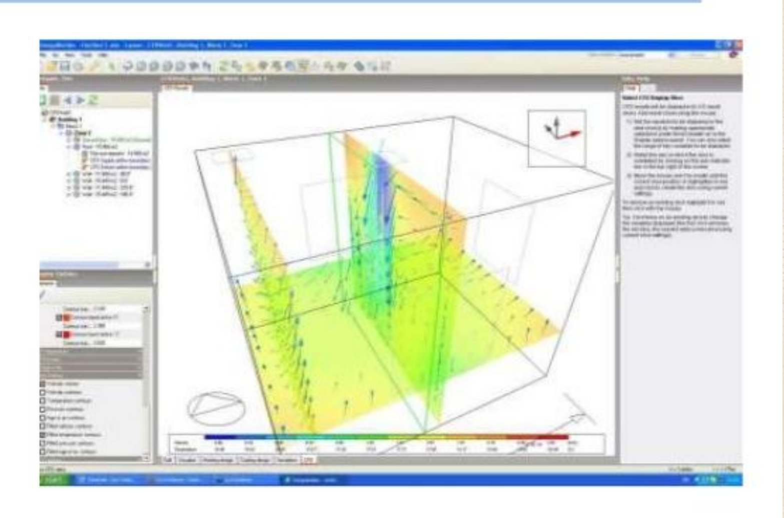



Exporting Revit Models to DesignBuilder
Revit BIM Model
Prepare "Analytical Model" within Revit
Open DesignBuilder Plugin from Revit Addins Toolbar
Open DesignBuilder from Plugin with Model Preloaded
Export gbXML file from Revit
Open DesignBuilder and Import gbXML
Option 1
DesignBuilder Revit Plugin
Option 2
gbXML Export - Import

DesignBuilder



DesignBuilder, a whole building energy use analysis simulation tool, is the oldest, easiest to use, most powerful graphical user interface to EnergyPlus available and includes ASHRAE 90.1 Appendix G Baseline HVAC System templates, materials, and construction libraries



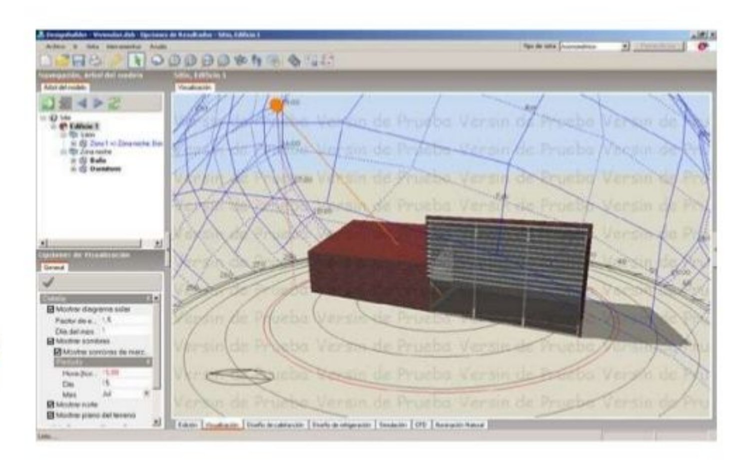
◆http://www.designbuilder.co.uk/

Note : This is good since we can change some or all input parameters and do more in-depth analysis, but it is bad for anyone who is not aware of the complexities of energy simulations. Plus you lose the ability to quickly compare different options within Revit.

DesignBuilder Packages for Architects

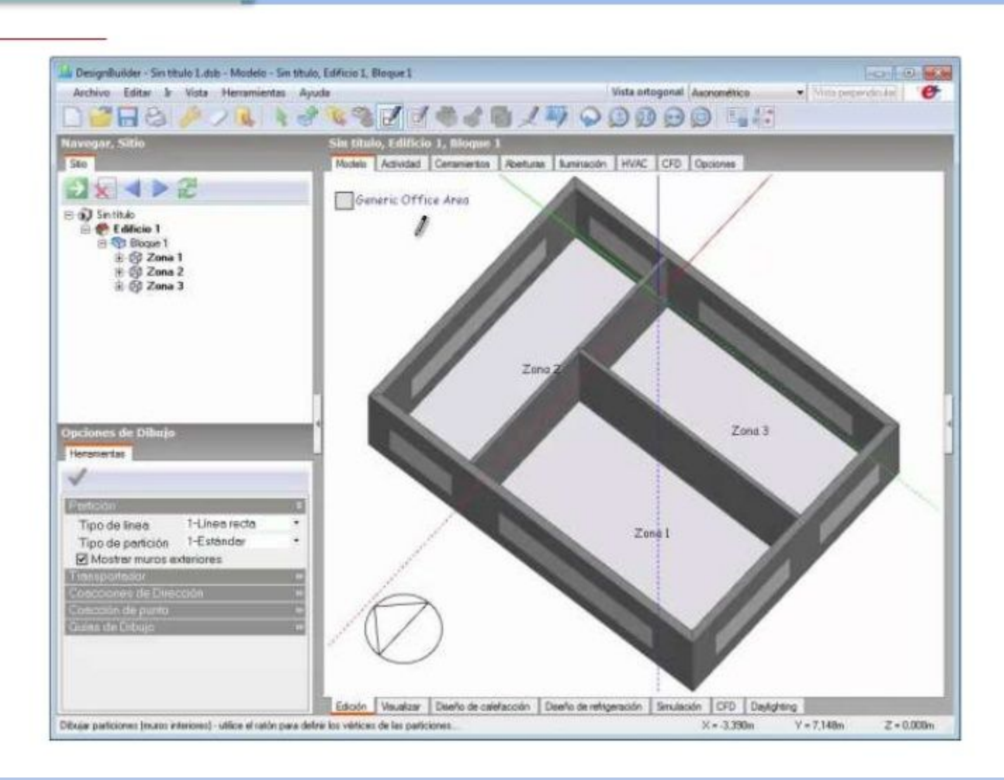
Solar calculations

- The Architectural simulation packages allow you to link with BIM solutions, analyse solar shading, maximise the use of renewable technologies and test facade options all in one place, adjusting as you go according to client requirements.
- High quality technical and rendered outputs help communicate findings to clients in a way they can easily understand. Key performance indicators such as energy consumption, carbon emissions, thermal comfort, daylight availability and cost can be provided throughout the design process in both naturally ventilated and air-conditioned buildings.



DesignBuilder Packages for Architects

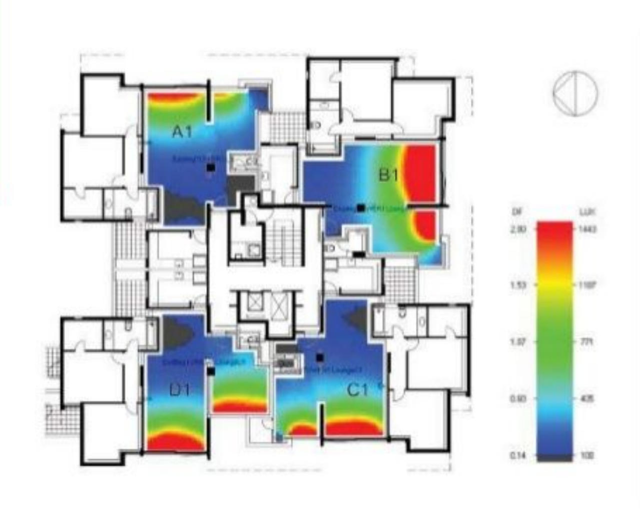
Interactive rendered views, shading and walk-throughs

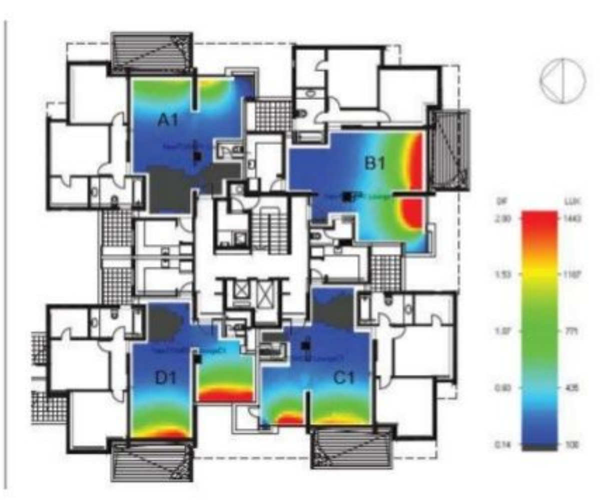


DesignBuilder Packages for Architects

Accurate daylighting calculations

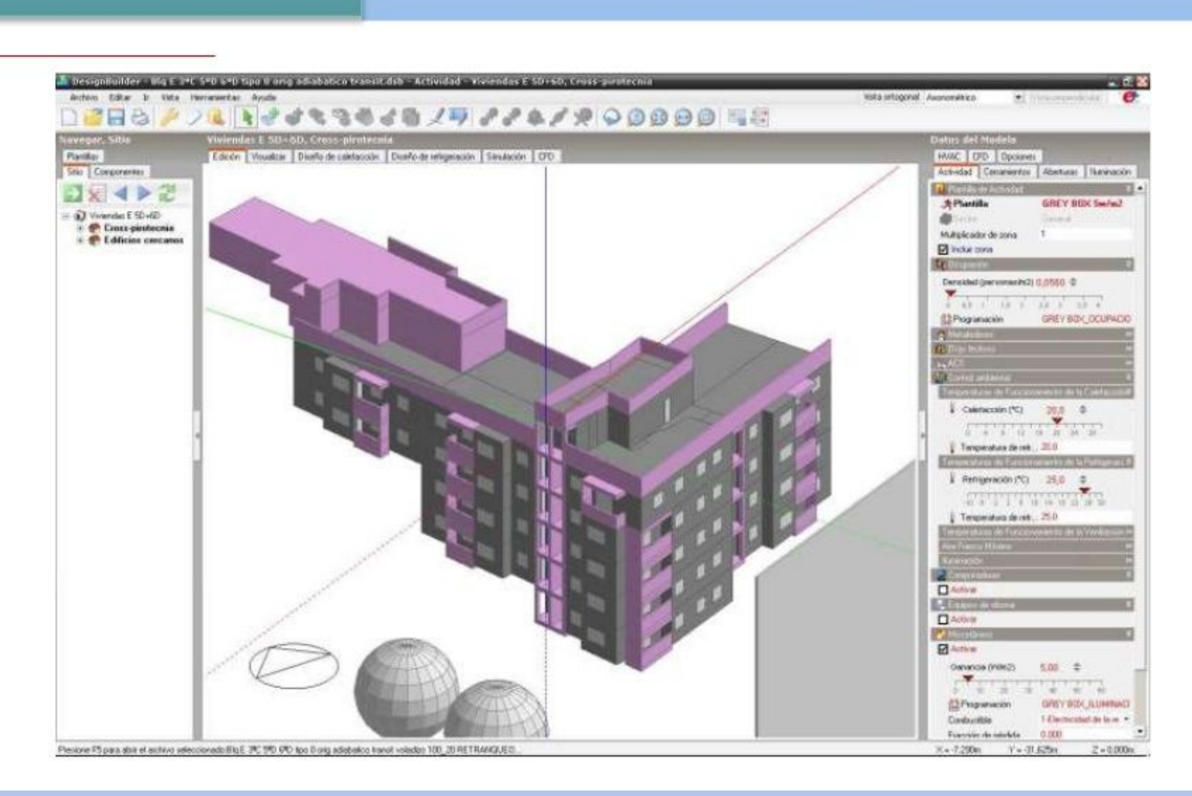
integrated generation of illuminance reports through Radiance





DesignBuilder Packages for Architects

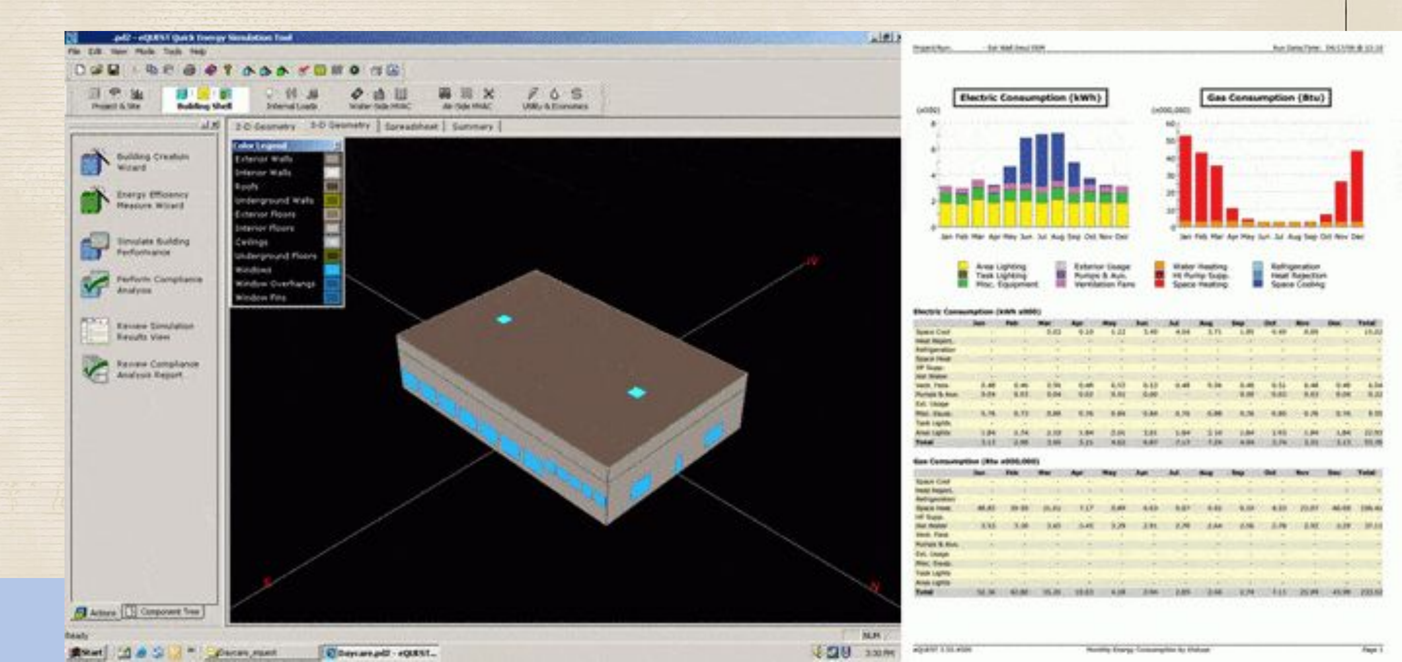
Import BIM models from Revit, SketchUp etc



eQUEST

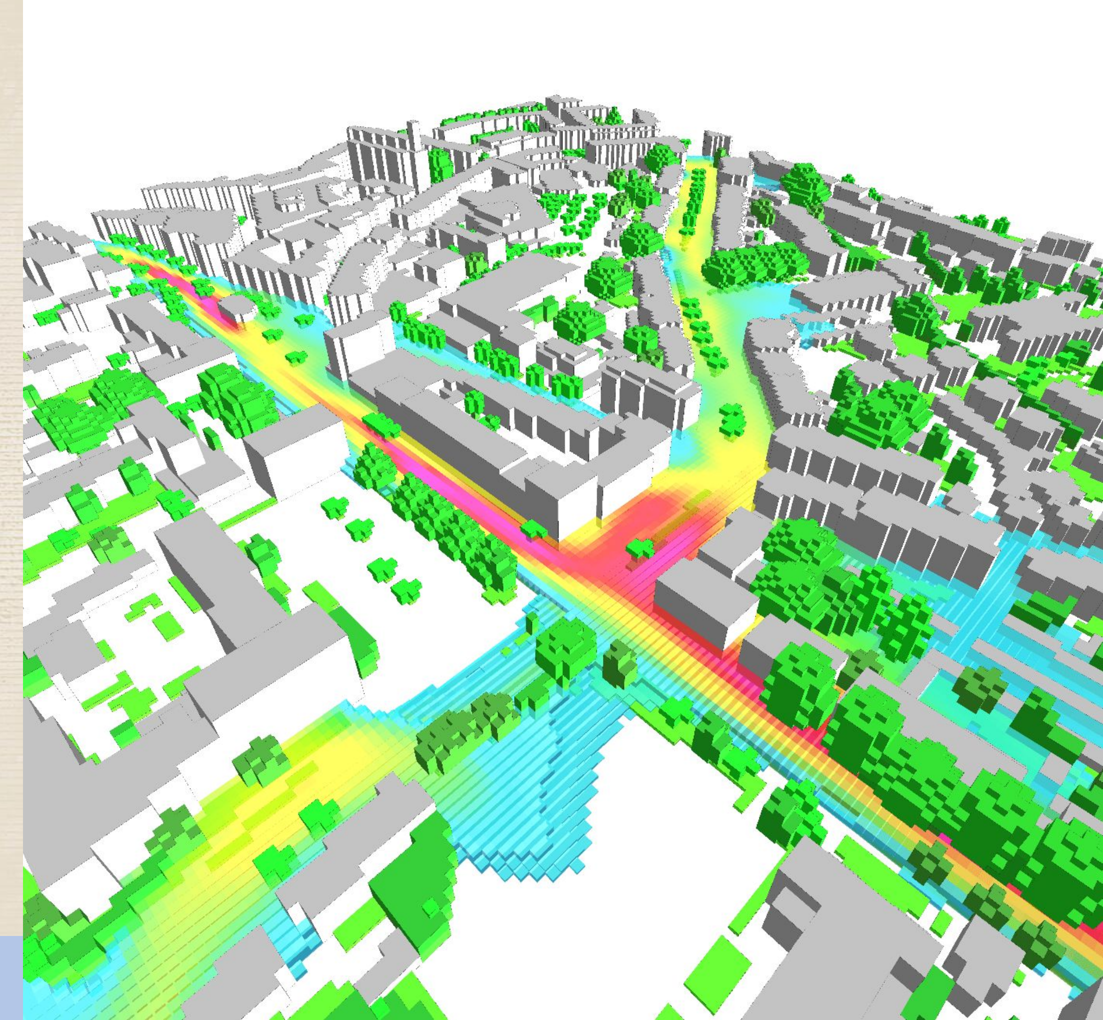
Imagine a building energy simulation tool comprehensive enough to be useful to ALL design team members, yet so intuitive ANY design team member could use it, in ANY or ALL design phases, including schematic design. eQUEST is well named because it provides something the you've been looking for, but have been unable to find … a sophisticated, yet easy-to-use building energy analysis tool. With eQUEST, you'll be able to provide professional-level results in an affordable level of effort.

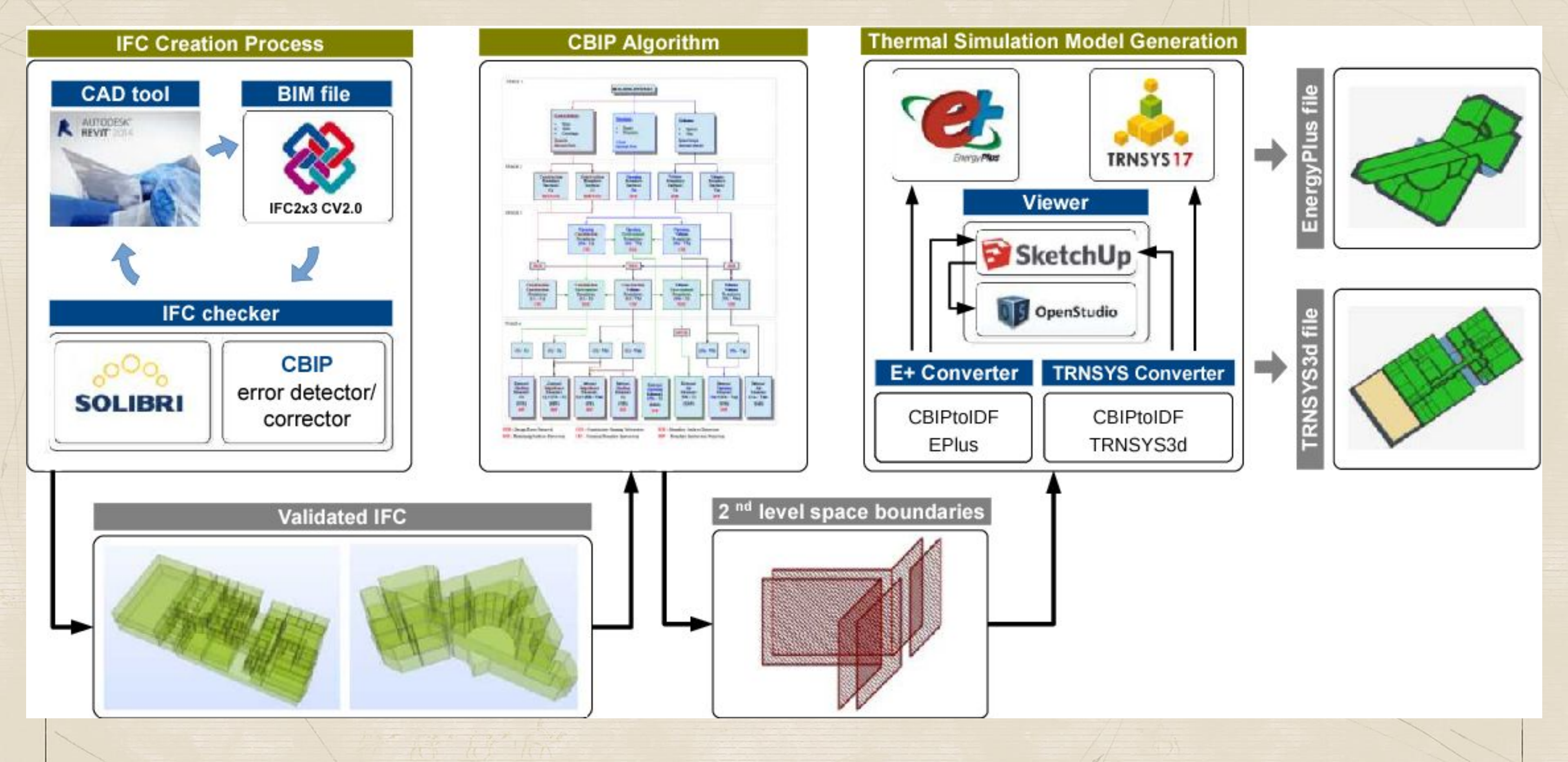
-Daylight



ENVI-met simulation

urban spaces master plans, physical planning morphology and help to draw a picture about the role of built environment elements, materials and vegetation on pedestrian perception and thermal comfort

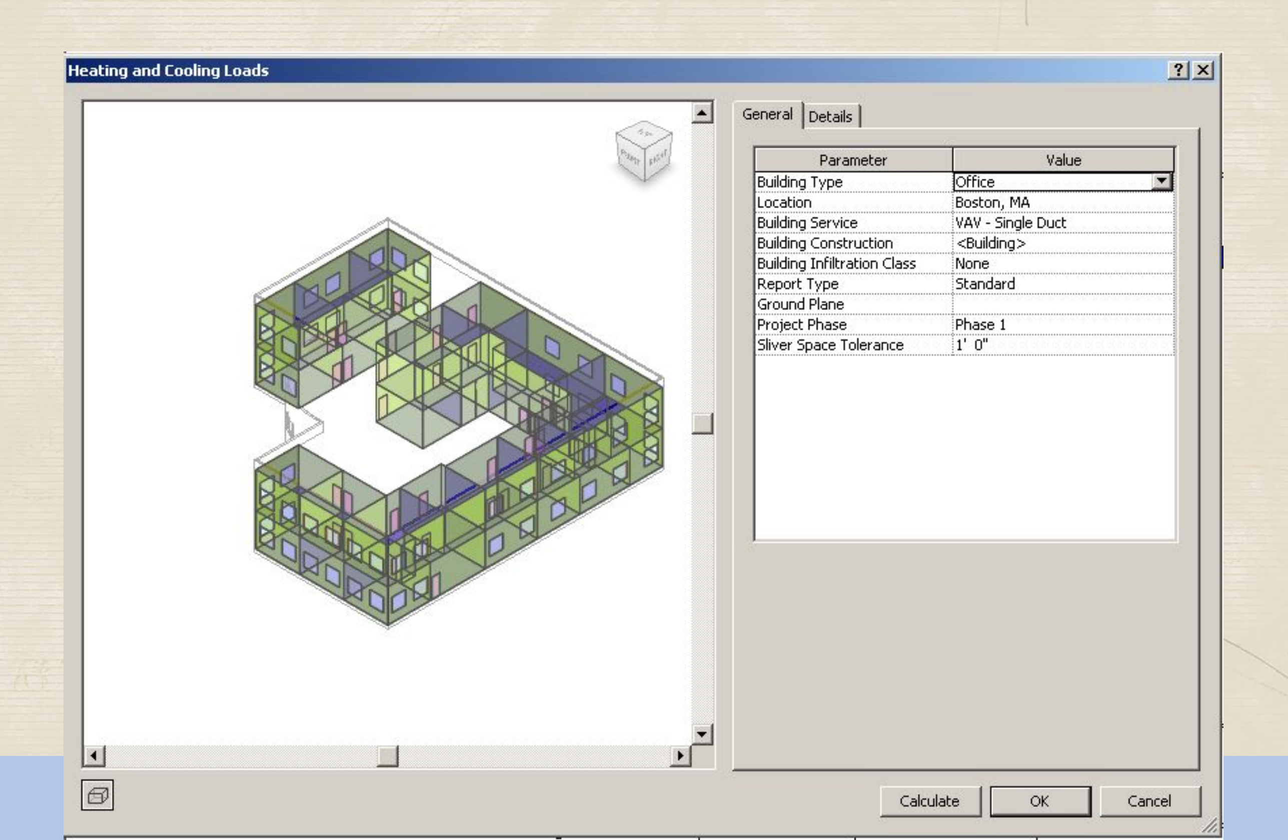



IFC Creation Process
CAD tool
BIM file
IFC2x3 CV2.0
IFC checker
SOLIBRI
CBIP
error detector/
corrector
CBIP Algorithm
Thermal Simulation Model Generation
EnergyPlus
TRNSYS 17
Viewer
SketchUp
OpenStudio
E+ Converter
TRNSYS Converter
CBIPtoIDF
EPlus
CBIPtoIDF
TRNSYS3d
EnergyPlus file
TRNSYS3d file
Validated IFC
2 nd level space boundaries

Way to BIM

Analytical Model Derived from gbXML

GREEN BUILDING XML



Data Sharing via IFC

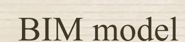
IFC platform provides a bi-directional data link to major energy analysis software











BIM model

Energy analysis applications

gbXML Support

- HVAC/Energy
  - CADLine
    - Cymap
  - Carrier
    - Hourly Analysis Program (HAP)
  - DOE-2.2 & eQuest (via GBS)
  - Elite Software
  - EnergyPlus (via GBS)
  - Energy Soft*
  - Environmental Design Solutions Ltd.
    - Tas
  - IES, Ltd.
    - IES <Virtual Environment>
  - Trane
    - TRACE 700

- CAD/BIM
  - Autodesk
    - AutoCAD Architecture & MEP
    - Revit Architecture & MEP
    - Green Building Studio (GBS)
    - Ecotect
  - Bentley
    - Architecture
    - Building Mechanical Systems
    - Speedikon Architectural
  - Google
    - SketchUp
  - Graphisoft
    - ArchiCAD
    - Mac and Windows

gbXML


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   <ZipcodeOrPostalCode>00000</ZipcodeOrPostalCode>
   <Longitude>31.37504</Longitude>
   <Latitude>30.12373</Latitude>
   <Elevation>74.0664</Elevation>
   <CADModelAzimuth>0</CADModelAzimuth>
   <Name>30.1237335205078,31.3750400543213</Name>
  </Location>
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   <StreetAddress>30.1237335205078,31.3750400543213</StreetAddress>
   <Area>2250.42</Area>
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    <PeopleHeatGain unit="WattPerPerson" heatGainType="Latent">58.61422</PeopleHeatGain>
    <PeopleHeatGain unit="WattPerPerson" heatGainType="Sensible">73.26777</PeopleHeatGain>
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    <EquipPowerPerArea unit="WattPerSquareMeter">13.99308</EquipPowerPerArea>
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      </CartesianPoint>
      <CartesianPoint>
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Sustainable Development Acronyms

RO (Renewable Obligation)
EU ETS (EU Emissions Trading Scheme)
CRC (Carbon Reduction Commitment)
FIT (Feed in Tariff)
RHI (Renewable Heat Initiative)
CCL (Climate Change Levy)
ECA (Enhanced Capital Allowances)
Part L (Building Regulations)
ZCH (Zero Carbon Homes)
CERT (Certified Emission Reduction Target)
CESP (Community Energy Saving Programme)
EPCs (Energy Performance Certificates)
DECs (Display Energy Certificates)
EPBD (Energy Performance of Building Directive)
CCA (Climate Change Act)
EU RED (EU Renewable Energy Directive)

LEED (Leadership in Energy and Environmental Design)
BREEAM (BRE Environmental Assessment Method)
CEN TC350 (EC Committee for Standardisation Technical Committee)
SAP (Standard Assessment Procedure for Energy Rating of Dwellings)
LCA (Life Cycle Assessment)
SBEM (Simplified Building Energy Model)
GHG (Greenhouse Gases)
PAS 2050 (Publicly Available Specification)
CSH (Code for Sustainable Homes)
RICS NRM (New Rules of Measurement Part 3)
ISO 15686 (International Standards Organisation Part 5)
BS58455 (British Standard 58455)


MASDAR

Case Study

MASDAR

- Funded by Mubadala Development Company
- Designed by Foster + Partners
- Powered entirely on solar energy and other renewable energy sources
- Zero-carbon, zero-waste ecology
- Abu Dhabi Future Energy Company (
- Projected to cost US$22 billion
- Started in 2006,
- First phase 2009
- 2.3 sq mi
- 50,000 people
- 1,500 businesses



Wa

MASDAR

- Masdar Institute of Science and Technology (MIST)
- Automobiles will be banned within the city
- Public mass transit and personal rapid transit systems
- City will be walled, to keep out the hot desert wind
- Narrow, shaded streets that will also funnel breezes
- Partners include through the Clean Tech Fund, GE, BP, Royal Dutch Shell, Mitsubishi, Rolls-Royce, Total S.A., Mitsui and Fiat

MASDAR

- Power Sources
- 40 to 60 megawatt solar power plant, built by the German firm Conergy (construction activity)
- Larger facility and additional photovoltaic modules will be placed on rooftops to provide supplemental solar energy totaling 130 megawatts
- Wind farms will be established outside the city's perimeter capable of producing up to 20 megawatts
- Geothermal power
- Hydrogen power plant
- The city will not produce enough energy to power itself at night
- Import gas-fired power from Abu Dhabi’s grid
- Carbon accounting by exporting excess solar power to the grid during the day

Case Study

MASDAR

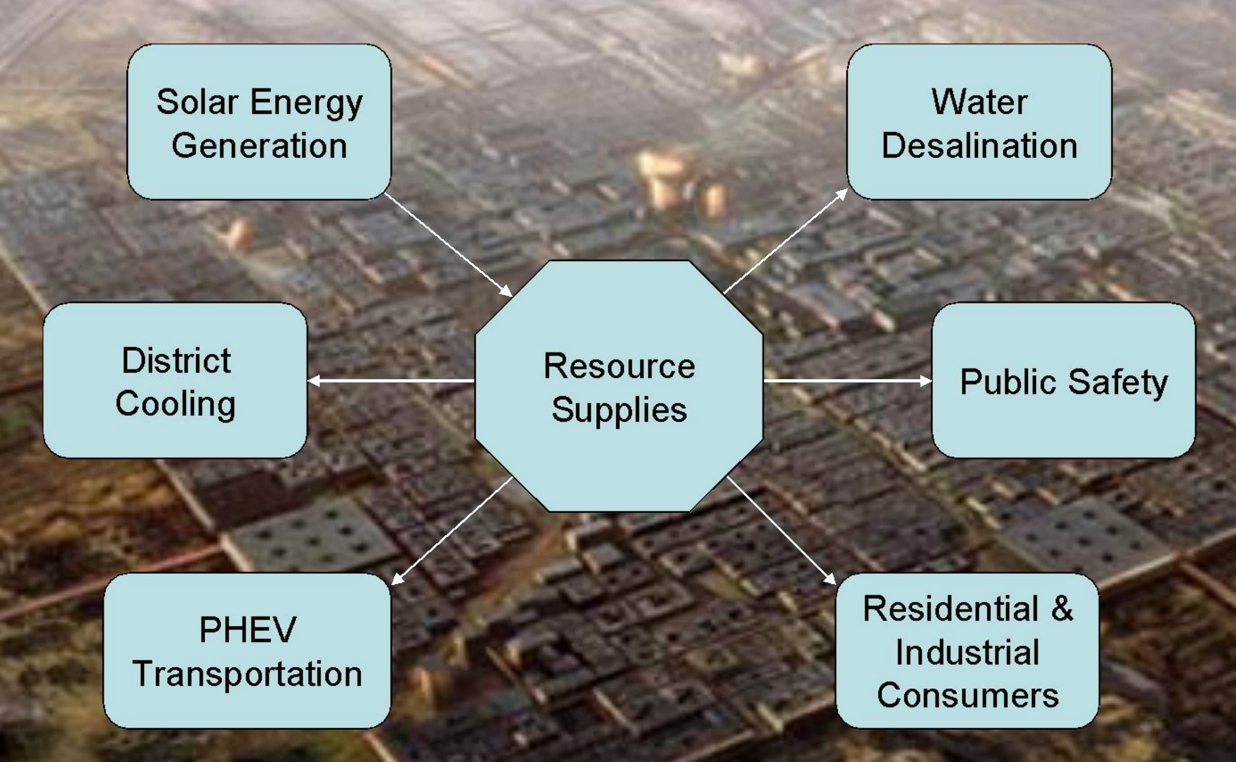
- Water
  - Solar-powered desalination plant
  - 60 percent lower water needs than similarly sized communities
  - 80 percent of the water used will be recycled
  - Attempt to reduce waste to zero
  - Biological waste will be used to create nutrient-rich soil and fertilizer
  - Waste incineration as an additional power source
  - Recycle





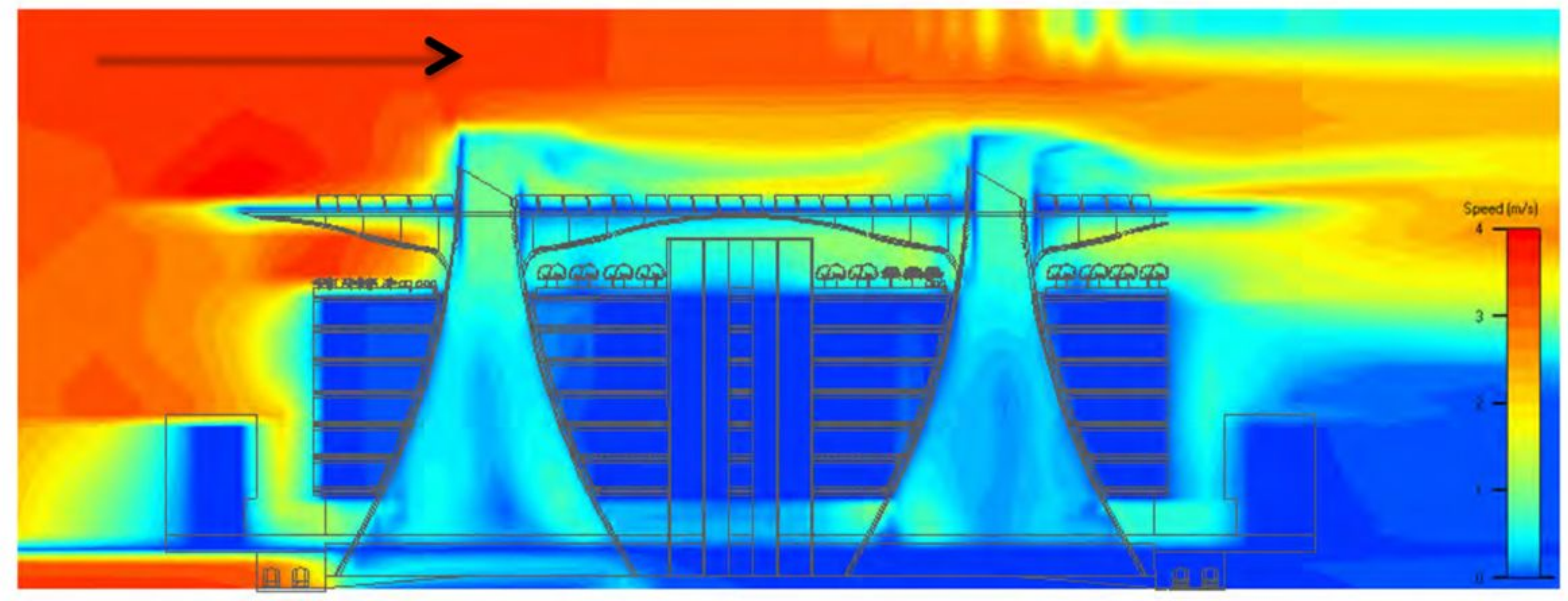
MASDAR-HEADQUARTERS

MASDAR – A Net-Zero City (2008)

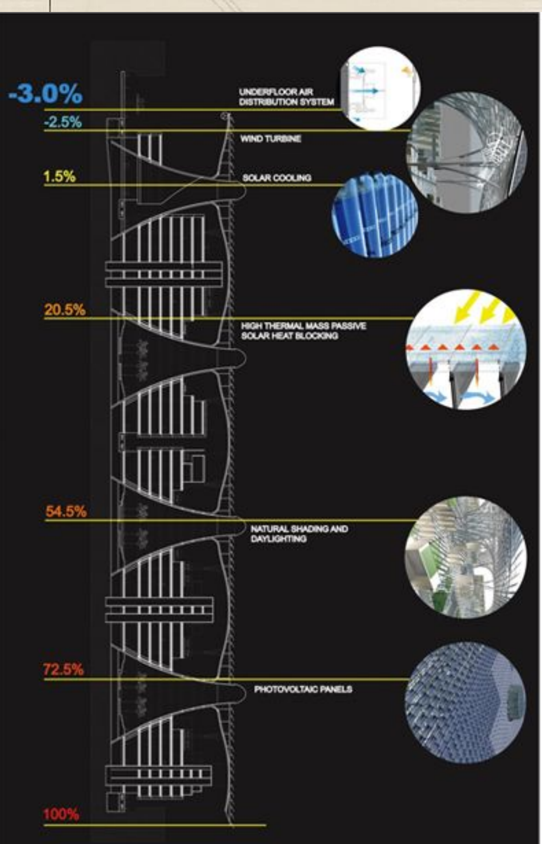


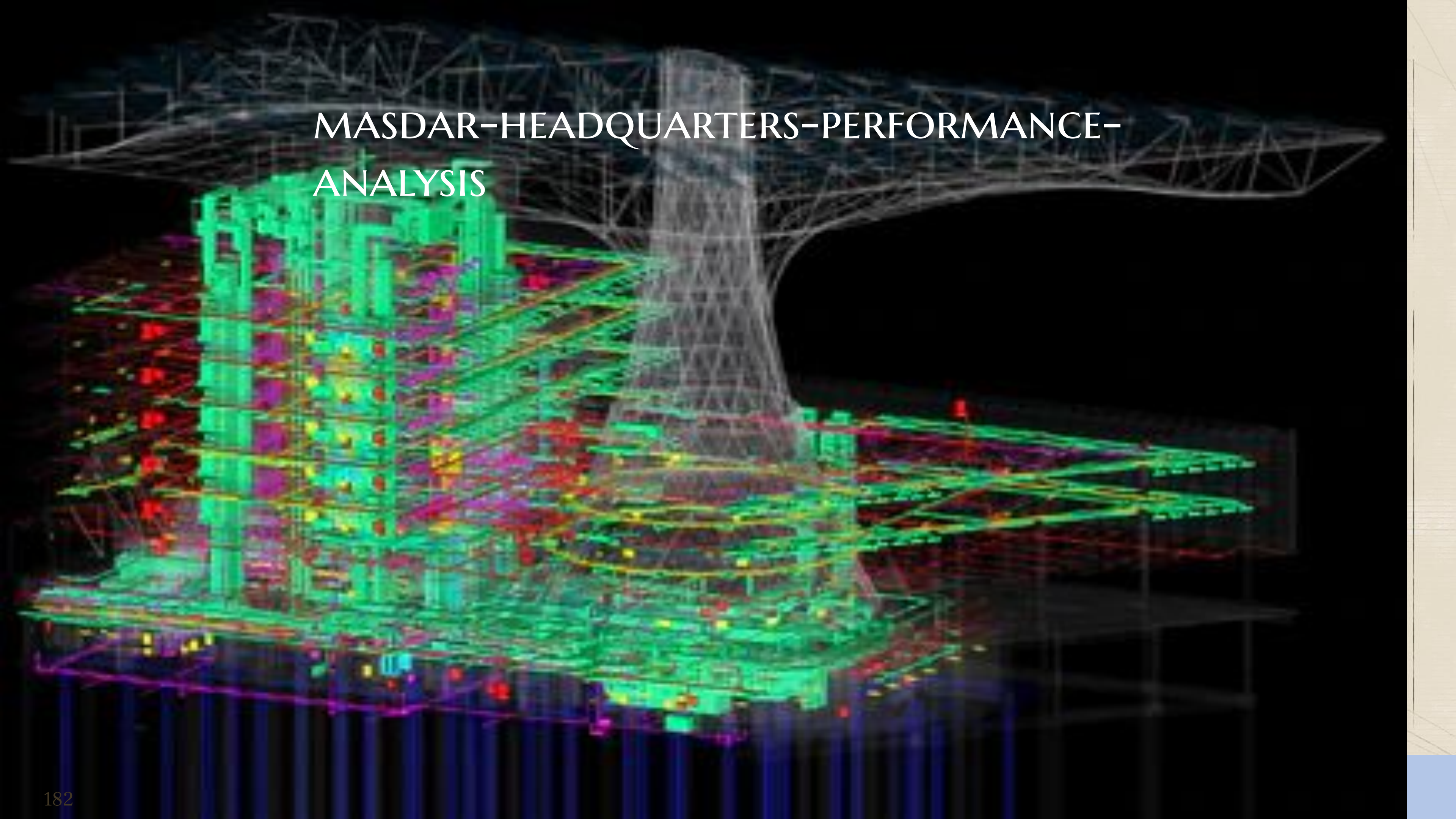
Question: How to allocate resources during a sandstorm?

MASDAR-HQ-VENTILATION-STRATEGY



MASDAR-HQ-SUSTAINABILITY-STRATEGIES-





MASDAR-HEADQUARTERS-PERFORMANCE-ANALYSIS

Case Study

MASDAR SYSTEMS

- **Building operation**
- Electrical generation and distribution
- Electrical energy meters
- Water meters
- Mechanical systems
- Public health systems
- Lighting control system
- Automated shading system
- Automated atrium roof lights
- Vertical transportation
- Public address system
- Digital signage system
- Sun tracking system
- Irrigation system
- Water features
- Information portal system
- Freight tracking RFID system

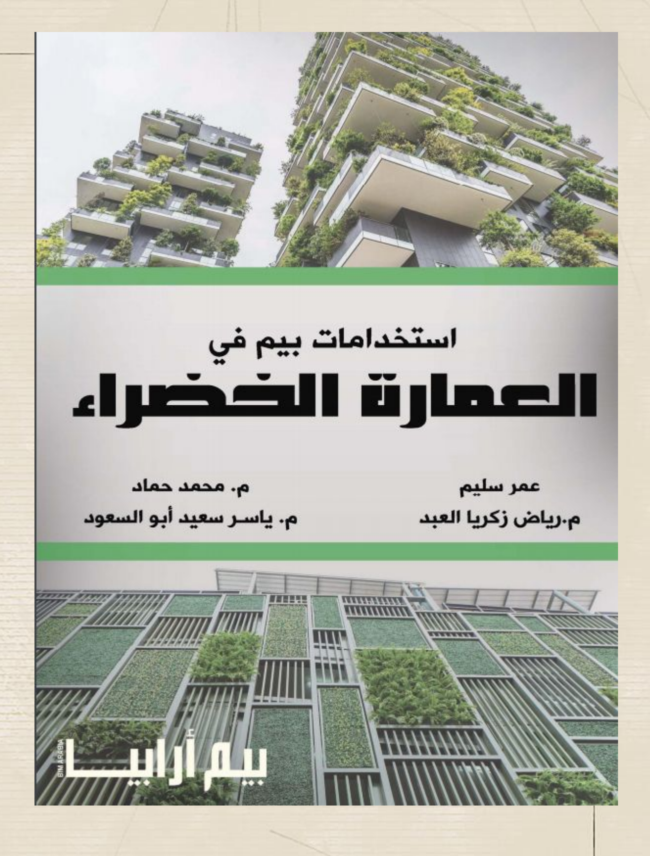
- Personnel RFID system
- MASDAR RFID tracking system
- Ventilation system for catering facilities
- Kitchen equipment
- Point of sale system
- Waste system
- Audio visual systems
- Library data base and alarm system
- Automated book storage facility
- **Transportation**
- PRT - Management centre
- PRT - Security system
- PRT - Ticketing system
- Vehicle management system
- LRT - Light Rail Transit System

MASDAR SYSTEMS

- **Life Safety and Security**
- Seismic monitoring
- Structural anti-corrosion monitoring
- Fire detection/alarm system
- Fire Suppression systems
- Intruder detection system
- Closed circuit television system
- Access control system
- Emergency lighting system
- Oxygen depletion monitoring system
- Refrigerant leak detection system
- Water leak detection system
- Disabled refuge telephone system
- Fire fighters telephone system
- Smoke extract system
- Fire pump
- Sump pumps

https://www.cpas-egypt.com/pdf/Omar_Slem/Book/Green_BIM.pdf استخدامات البيم في العمارة الخضراء

https://www.youtube.com/playlist?list=PLNMim060_nUJRgifCygsgxKSnMp9b9cwc



Thanks!

Any questions?

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- oselim@bimarabia.com

